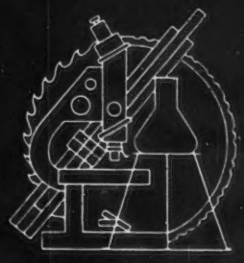
UREA-RESIN GLUES AT HIGH TEMPERATURES, p. 28

Forest Products Journal



Trends in Home Construction

Authors in the fields of Architecture, Furniture, Millwork, Precut and Prefabricated Housing discuss the future of wood in home construction:

- ***Some unexplored uses for wood in home design . . . . . p. 19-A***
- ***The modular system—standardization, better design, and economies in furniture and millwork pp. 22-A, 24-A***
- ***The evolution of home construction from craft to industry . . . . . p. 25-A***
- ***Opportunities for prefabrication—new finishing techniques are needed . . . . . p. 27-A***

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CYANAMID

ADHESIVE NEWS

"We cannot afford to use any other adhesive than URAC® 185"

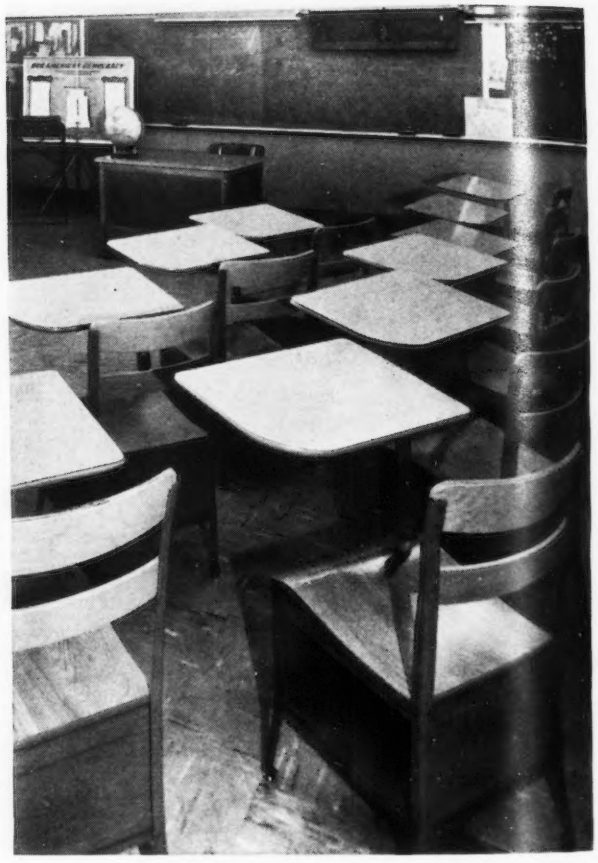
says MARK PRICE, president of Desk Tops Inc., Cleveland, Ohio

Claiming 75% of the market for school desk tops east of the Mississippi, Desk Tops Inc. cannot afford a faulty glue line in its laminated tops.

Mr. Price says, "A delamination caused by a faulty glue line is unheard of by this company. Our customers expect us to guarantee our tops against this failure. Consequently, we believe we *must* continue to use URAC 185, which has served us so well."

URAC 185 makes one of the strongest possible joints between the hardwood plywood cores and rich melamine plastic surfaces. It is both gap-filling and craze resistant, and so moisture resistant that tests have shown wood to deteriorate before the bond. Moisture resistance is particularly welcome in cafeteria table tops, for it eliminates the risk of edge delamination starting from wet spills or washing.

URAC 185 is easy to work with, setting at room temperature under low pressure, and it can also be used with strip heating. It's the ideal adhesive for assembly gluing of furniture, sports goods, millwork, joint assemblies, bonding of decorative laminates and lumber core bonding. For details, please write or call.



Plastic desk tops are here to stay—about 80% of all school furniture sold last year "went plastic." Big supplier of plastic tops for desks and tables is Desk Tops Inc., which accepts no substitutes for URAC 185 Resin Adhesive as the bonding agent.

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FOREST PRODUCTS JOURNAL

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Sept. 27–28: Inland Empire Section Meeting, Omak, Wash.

Oct. 7–8: Pacific Northwest Section Meeting, Portland, Ore.

Oct. 17–18: Ohio Valley Section Meeting, New Albany, Ind.

Oct. 21–22: Mid-South Section Meeting, Crossett, Ark.

Oct. 31–Nov. 1: Northeast Section Meeting, New York City

Oct. 31-Nov. 1: Carolinas–Chesapeake Section Meeting, Roanoke, Va.

Nov. 8: Rocky Mountain Section Meeting, Denver, Colo.

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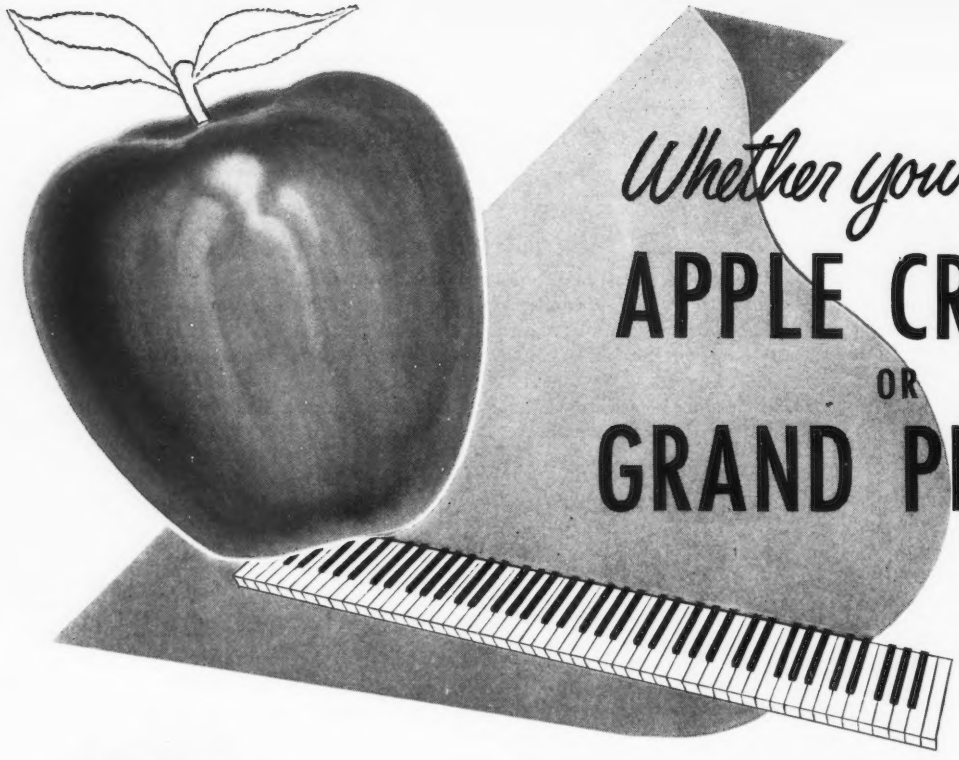

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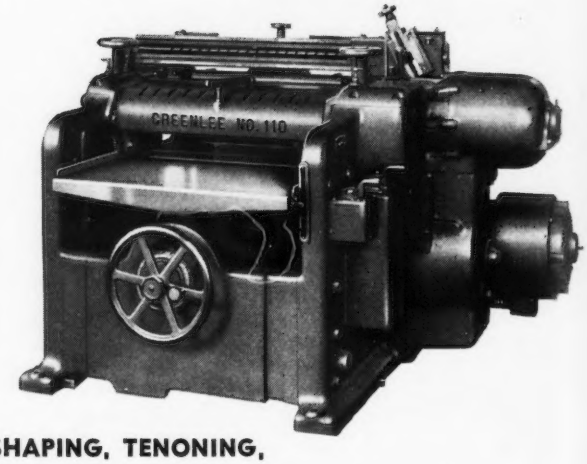

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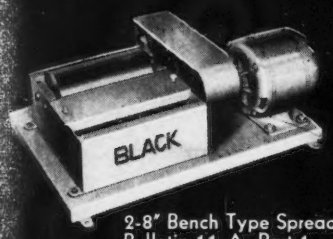

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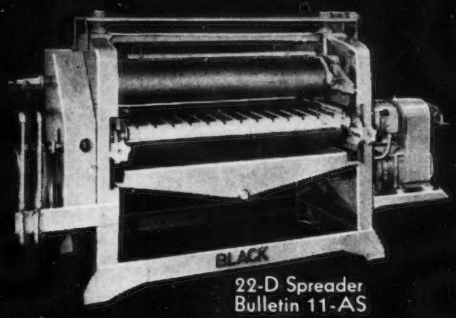

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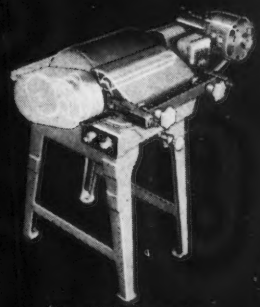
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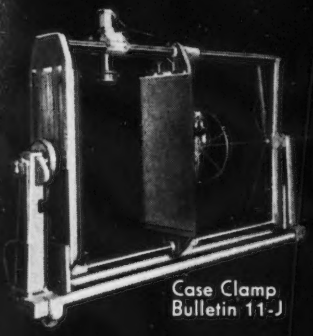
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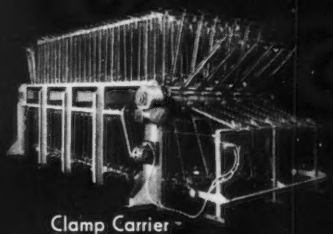
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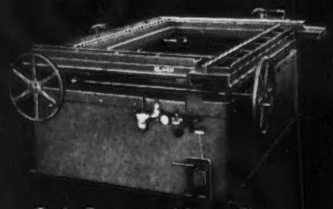
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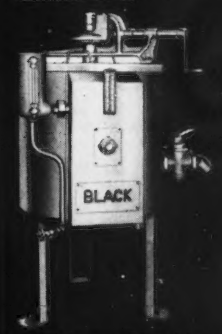

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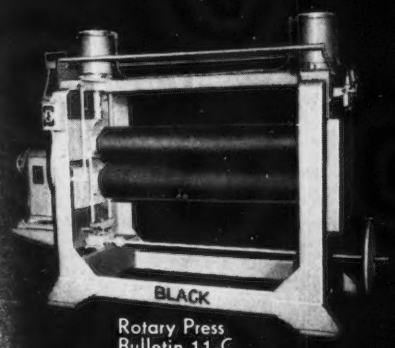

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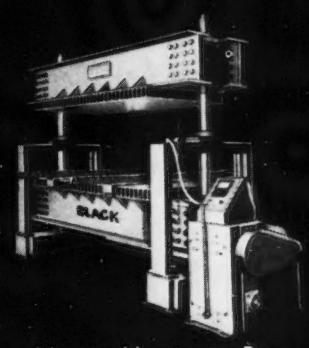

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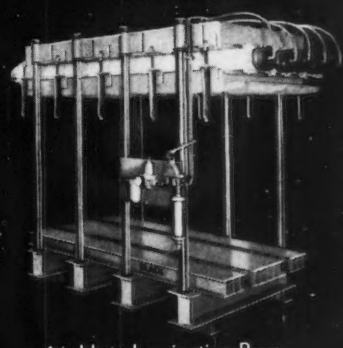
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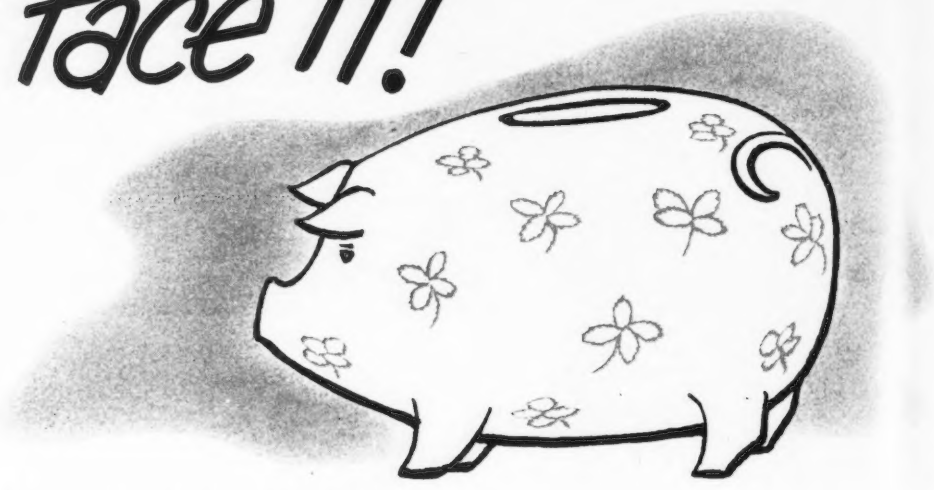
Let's Face It!



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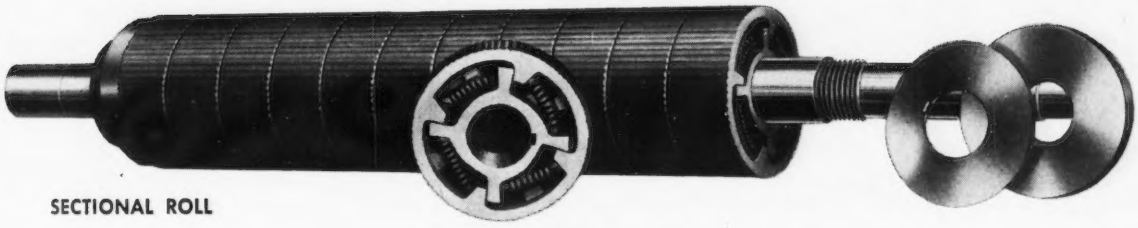

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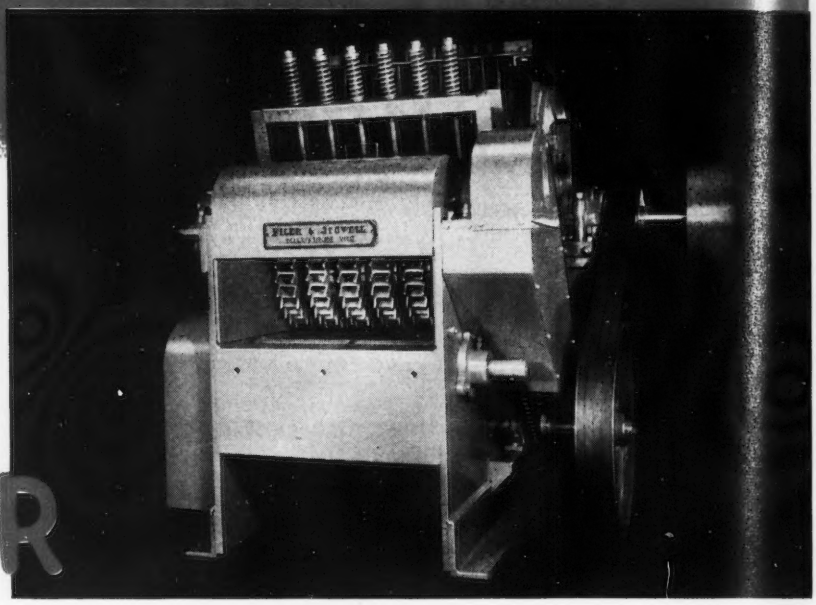

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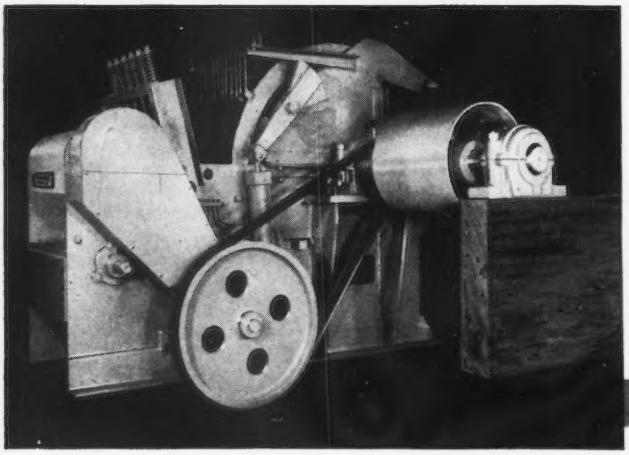

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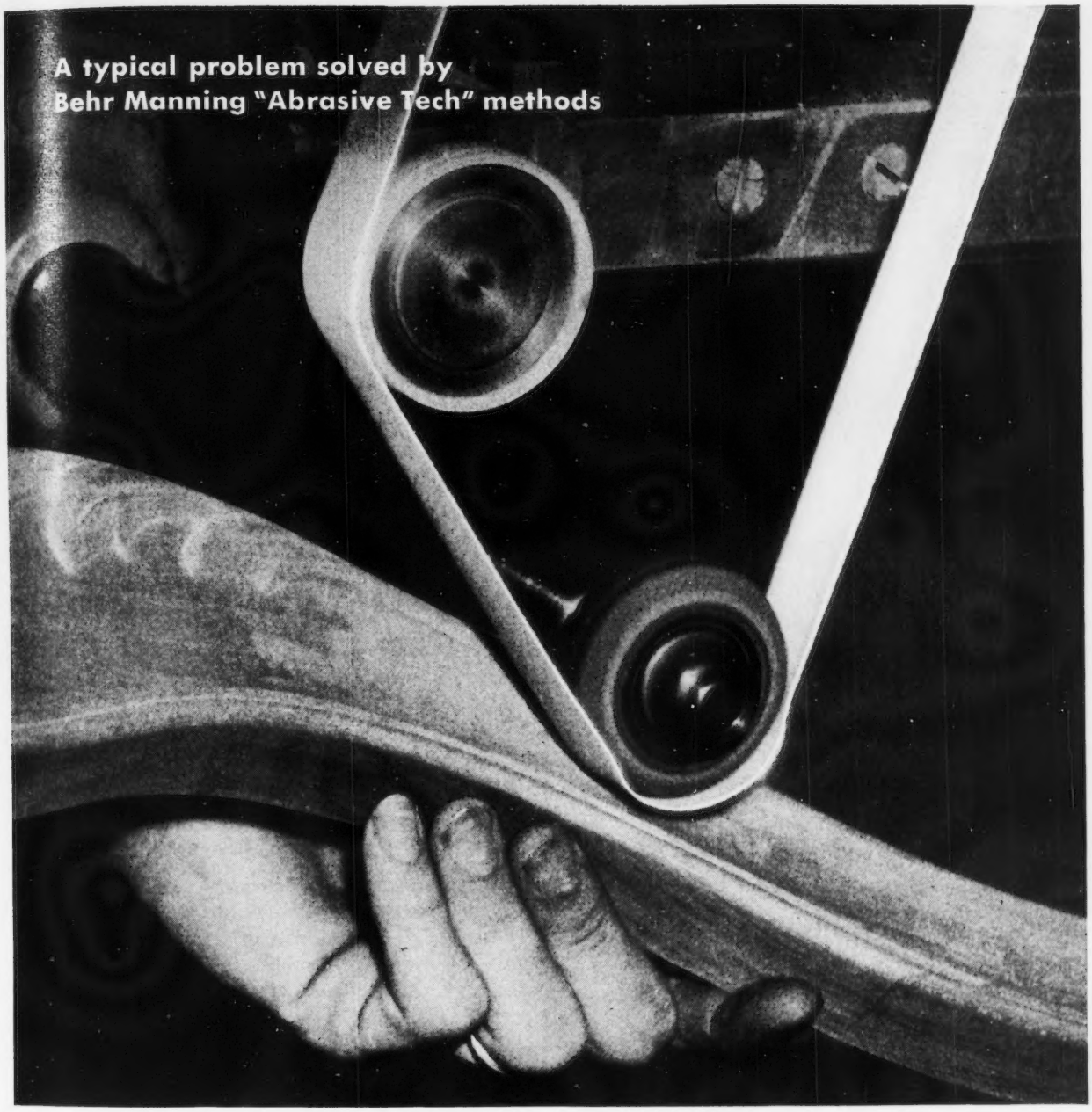

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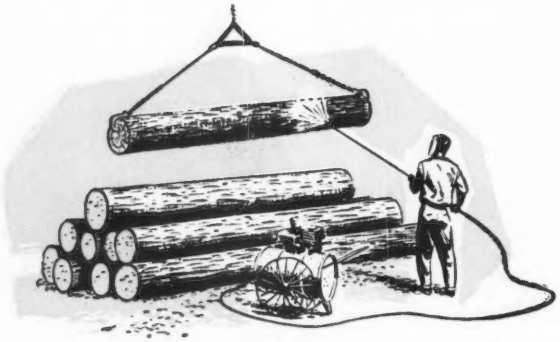

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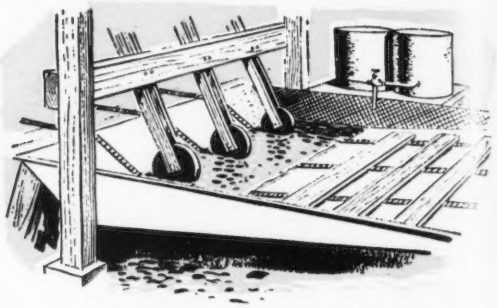

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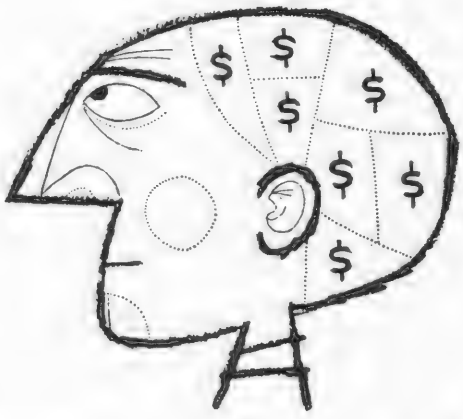

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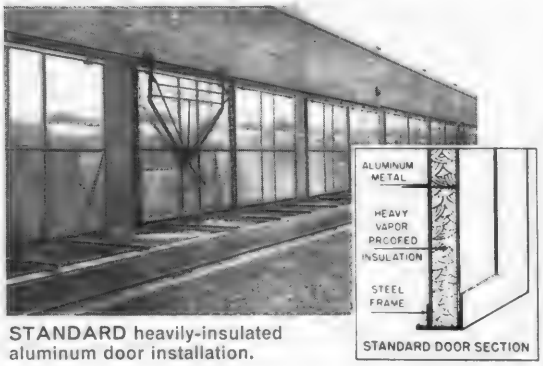

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FPRS NEWS-DIGEST

Volume VII AUGUST, 1957 Number 8

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Thirty forestry schools and over 50 firms participate in the program. During the National Meeting, four employment periods, from two to four hours per day, were operated by the committee, handling over 50 contacts.

In other actions, the executive board:

- Authorized preparation of a "Handbook for Section Officers", to be published in the fall of 1957.
- Is to send copies of model by-laws and differences between existing section by-laws to each section in the interest of adopting uniform by-laws throughout the organization.
- Reviewed recommendations made by the Divisions and agreed to proceed with the preparation of a "Guide for FPRS Division Chairmen".
- Approved preparation of a questionnaire to the membership to determine

Members of the 1958 National Meeting Steering Committee met recently in Madison. The 12th Annual Meeting at Madison, Wis., will feature technical sessions, division meetings, conducted tours of the U. S. Forest Products Laboratory, and individual consultations by appointment with laboratory staff members. Shown standing from left to right are: F. H. Kaufert, William Kluender, Gardner Garlick, and F. J. Rovsek. Seated are John Killebrew and Robert Hiller. Not shown are J. J. Allegretti and Walter T. Noble.

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the members' relative interest and preference in the work of each of the Society's 14 Divisions.

• Changed the name of the Marketing Division to Merchandising Division.

• Named R. H. Berry General Chairman of the 13th National Meeting to be held, June 28, 29, 30, and July 1 and 2, 1959, at San Francisco, Calif.

• Accepted an offer submitted through the FPRS Wood Drying Division by the Moore Dry Kiln Co. to underwrite an honorarium to be known as the Charles Williams Memorial Lecture during the 1958 National Meeting. Three hundred dollars will be awarded by the Moore Dry Kiln Co. to Harry Tiemann toward preparation of the lecture.

• Approved publication of a new alphabetical membership directory, to be available on or about January 1, 1958.

• Scheduled the next meeting of the Executive Board for September 19–20, at the Loraine Hotel, Madison, Wis.

Division Activity Lauded By Kaufert

The growing importance and strength of the Society is due in large measure to the excellent work of the Divisions F. H. Kaufert, President, FPRS, said in a recent letter to outgoing and current Division Chairmen and Vice Chairmen. Mr. Kaufert praised the work of Division officers in performing their several functions.

The annual meeting technical sessions, he said, are part of the backbone of the Society. "During and since the Buffalo meetings, I and members of the Executive Board have had numerous communications from members and others commenting on the excellence of the Buffalo technical sessions", Mr. Kaufert said. He extended congratulations for a job well done.

He acknowledged that there is room for improvement in the program but said that, "judging from the many fine comments we have had, our technical sessions at annual meetings are developing and being strengthened annually".

The following is a list of Divisions and officers for 1957–58.

Division Officers

Logging

Chairman—Fred C. Simmons, Northeast Forest Experiment Station, Upper Darby, Pa.
Vice Chairman—Paul M. Dunn, St. Regis Paper Co., New York, N. Y.

Lumber Manufacture

Chairman—Milton H. Mater, Mater Engineering, Corvallis, Ore.
Vice Chairman—E. P. Ivory, Ivory Pine Co., Dinuba, Calif.

Machining & Equipment

Chairman—Norman C. Bye, H. K. Porter Co., Inc. of Pitt., Henry Disston Div., Philadelphia, Pa.
Vice Chairman—R. J. Hoyle, N. Y. State University College of Forestry, Syracuse, N. Y.

Finishing

Chairman—F. H. Thomas, Sherwin-Williams Co., Chicago, Ill.
Vice Chairman—D. G. Lubeck, Hammond Organ Co., Chicago, Ill.

Wood Preservation

Chairman—C. S. Walters, Illinois Agricultural Experiment Station, Urbana, Ill.
Vice Chairman—A. H. Bishop, N. Y. State University College of Forestry, Syracuse, N. Y.

Composition Board

Chairman—J. R. Roberts, Weyerhaeuser Timber Co., Longview, Wash.
Vice Chairman—Arthur Mottet, International Paper Co., Long-Bell Div., Longview, Wash.

Glues & Gluing

Chairman—R. F. Blomquist, U. S. Forest Products Lab., Madison, Wis.
Vice Chairman—B. S. Bryant, University of Washington, College of Forestry, Seattle, Wash.

Chemical Utilization

Chairman—A. S. Gregory, Weyerhaeuser Timber Co., Longview, Wash.
Vice Chairman—Irwin Pearl, Institute of Paper Chemistry, Appleton, Wis.

Quality Control

Chairman—Charles Latimer, Nickey Bros., Inc., Memphis, Tenn.
Vice Chairman—Richard C. Callahan, Singer Mfg. Co., Ltd., Singer Clydebank, Scotland.

Veneer & Plywood

Chairman—John Butler, Hardwood Plywood Inst., Atlanta, Ga.
Vice Chairman—John F. Lutz, U. S. Forest Products Lab., Madison, Wis.

Industry-Education

Chairman—James S. Bethel, N. C. State College, School of Forestry, Raleigh, N. C.

Drying

Chairman—Stephen B. Preston, University of Michigan, School of Natural Resources, Ann Arbor, Mich.
Vice Chairman—John M. McMillen, U. S. Forest Products Lab., Madison, Wis.

Packaging

Chairman—A. R. Tegge, Jr., Quartermaster Food and Container Institute, Chicago, Ill.

Merchandising

Chairman—R. D. Pauley, Mgr., Weyerhaeuser Timber Co., Tacoma, Wash.
Vice Chairman—George E. Olson, Dow Chemical Co., Midland, Mich.

E. H. Roche Resigns As JOURNAL Editor

E. H. ROCHE

Edward H. Roche, editor of the FOREST PRODUCTS JOURNAL for the past two and a half years, recently resigned from his position to become editor of the EXTENSION SERVICE REVIEW, monthly magazine of the Federal Extension Service, USDA, Washington, D. C. The REVIEW, with approximately 17,000 circulation, serves county agents connected with the U. S. Department of Agriculture extension service.

Mr. Roche, a native of Auburn, N. Y., left FPRS August 2. He was Publications Editor at the State University of N. Y. College of Forestry at Syracuse before joining FPRS and received his B.A. degree in journalism and political science from Syracuse University in January 1949. For a year and a half after his graduation, he was editor and production manager of six county Farm Bureau publications

Division Chairmen luncheon at the recent 11th National Meeting in Buffalo, (June 23–28).

R. H. Hamre Appointed Editor FPRS JOURNAL

Robert H. Hamre, Monona Village, Wis. has been appointed editor of the FOREST PRODUCTS JOURNAL. Hamre assumed his duties as editor on August 12.

R. H. HAMRE

Former Technical Editor for American Scientific Laboratories Inc., Madison, Wis., he holds two degrees from the University of Wisconsin, the first a B.S. degree in chemistry received June 1952 and the second an M.S. degree in agricultural journalism received this August.

He was employed by the Carrier Corp., Syracuse, N. Y., from June 1952 until July 1955 with a two-year tour of army duty in between. While at Carrier Corp. he was responsible for the editing of engineering manuals. Hamre joined the staff of the U. S. Forest Products Laboratory, Madison, Wis., in July 1955 and was employed for 1½ years as an editor in research publications.

A native of Berlin, Wisconsin, Hamre, age 27, is married and the father of three daughters.

$23,000 Received Toward Building Fund

The Executive Office Building Fund for purposes of establishing a permanent home office in Madison, Wis., continues to grow toward its objective of $60,000, according to latest reports from Raymond H. Berry.

Since January 1, and as of August, $23,000 in cash and pledges have been reported. The Fund-Raising Committee is redoubling its efforts at this time to reach a $35,000 goal by September 19–20, so that construction may get underway.

If you or your company have not yet contributed, you may wish to use the coupon at the right.

Cash contributions or pledges in major amounts have been received in recent weeks from the following organizations and individuals:

Cash Contributions:

Bayport Foundations, $250
The Harden Co., New York, N. Y., $250
Mel-O-Johnson Machine Co., Minneapolis, Minn., $50
Miller-California Lumber Co., $500
Simpson Timber Co., $1,000
Sodeman Machine Mfg. Co., Talladega, Ala., $200
Wood Conversion Co., Cloquet, Minn. $50
Wood-Metal Industries, Inc., Kramer, Pa., $100

Pledges:

Fred E. Barnett Co., San Francisco, Calif., $250
Dexter D. Hulsart, Tuscaloosa, Ala., $100
Owens-Illinois Plywood Co., North Troy, Vt., $250
Pacific Lumber Co., Chicago, Ill., $1,000
The Pacific Coast Co., Willits, Calif., $50

The standing of the Regions to date are:

	Goal	Contribution
South West	8,000	6,215
North West	12,000	5,475
South Central	4,000	2,215
South East	8,000	3,045
North Central	14,000	2,540
North East	14,000	2,505
Other	---	1,280
	60,000	23,275

Tours to Be Featured at Mid-South Meeting

"Forests and Their Products" is the theme of the Mid-South Section Meeting, October 21–22, at the Rose Inn, Crossett, Ark., according to W. L. Lear, secretary-treasurer of the section.

Highlighting the theme will be a series of tours of the Crossett Experimental Forest, a branch of the Southern Forest Experiment Station at New Orleans, and of the Crossett Co. plants, including the sawmill division, chemical plant, and paper mills. J. H. Rowland, Reynolds Metals Co., will speak at the official dinner, October 21, and the official luncheon speaker, October 22, will be T. L. Latané Temple, III, Southern Pine Lumber Co., Diboll, Texas.

A panel discussion on "How Good A Tree Should We Grow" will be moderated by R. R. Reynolds, Crossett Experimental Forest. Panel members include: M. A. West, Texas Creosoting Co., Orange, Texas; George Stanley, Kirby Lumber Corp., Houston, Texas; B. E. Mikulka, Love Wood Products, Diboll, Texas; and Russell Stadelman, Nickey Bros. Inc., Memphis, Tenn.

Registration fee is $6.00 for members and non-members and hotel reservations and preregistration should be made through W. L. Lear, Crossett Lumber Co., Crossett, Ark.

New York City Site of Fall Northeast Section Meeting

The fall meeting of the Northeast Section, October 31-November 1, will be held at the Prince George Hotel in New York City, says William J. Delmhorst, outgoing section secretary.

New officers elected at the Northeast Section Meeting, June 22, at Buffalo are: Eric Anderson, N. Y. State College of Forestry, Syracuse, Chairman; J. Allen Hauter, Allan Products Co., Oradell, N. Y. Vice Chairman; Benjamin Jayne, Yale University School of Forestry, New Haven, Conn., Secretary-Treasurer; and Richard West, Forestry Department, Rutgers University, New Brunswick, N. J., Coordinator.

Waste Utilization Theme of Rocky Mountain Meeting

The fall meeting of the Rocky Mountain Section, November 8, at Denver, Colo., will have as its theme "Waste Wood Utilization", according to W. R. Fritze, program chairman. Headquarters for the meeting will be the Cosmopolitan Hotel. Four speakers scheduled for the meeting will be announced in the near future.

CONTRIBUTION OR PLEDGE CARD

Name _____

Address _____

I hereby (contribute) (pledge) my support to the proposed FPRS Executive Office Building to be erected as early as possible, consistent with conservative business practice, in Madison, Wisconsin.

(Check here for Contribution and enclose check or money order) ☐ $_____

(Check here for Pledge. We will invoice you for the amount of pledge during calendar year 1957) ☐ $_____

Signed _____

Improved Utilization Theme of Inland Empire Meeting

Improved utilization at sawmills is the theme of the Inland Empire Section fall meeting, September 27–28, at Omak, Wash., according to Herbert B. McKean, chairman of the section. Featured the first day of the meeting will be tours through the Biles-Coleman Lumber Co. operations, including the sawmill and logging divisions.

The Saturday morning technical session will include five speakers. Milton H. Mater, Mater Engineering, Corvallis, Ore., will talk on methods of improving sawmill efficiency. Paul Watts, P. Watts, Inc., Cincinnati, Ohio, will present information on the cut stock business, while the Wyssen Skyline Logger will be discussed by E. S. Kotok, Chief, Forest Utilization Service, Ogden, Utah.

A representative of Mann Russell Co. will describe methods of electronic gluing, and a speaker from the Dominion Bridge Co. will talk on gang saws for log break down. The Friday luncheon will feature descriptions of the Wyssen Skyline Logging System, and a social hour and banquet will be held Friday evening.

Descriptions of several scenic routes in and out of Omak are available from the section, including those routes permitting views of Grand Coulee Dam, Chief Joseph Dam, Lake Chelan, and routes through Canada.

Panels to Be Featured at Ohio Valley Meeting

The fall meeting of the Ohio Valley Section, October 17–18, will be held at New Albany, Ind. John Wilson, section chairman, says that features of the meeting will include a paper on veneer splicing presented by H. O. Fleischer, U. S. Forest Products Laboratory, Madison, Wis., and panel discussions on finishing, packaging, sanding, and rough mill procedure.

Registration will begin 12 noon Thursday, October 17, and be followed by the keynote speaker at 1 p.m. A plant tour is scheduled for 1:15 p.m., October 18, which will end the meeting.

Great Lakes Section to Hold Plywood Warpage Clinic

Gardner Garlick, chairman of the Great Lakes Section, announced that the fall meeting of the Section will take the form of a Plywood Warpage Clinic.

The Clinic will be held Friday, October 11, at the Warm Friend Tavern, Holland, Michigan, according to Brooks Applegate, section secretary.

Hess, Wood Fiber Expert, Named Director of Research

R. W. HESS

Named Director of Research recently for the Georgia - Pacific Corp. is Dr. Robert W. Hess. A researcher in wood fiber, Dr. Hess has been Associate Professor of Forestry at Yale University in charge of Woods Research.

He was head of the Wood and Plastic Research Division of Curtis-Wright Corp., and before joining Georgia-Pacific, was Director of Research and General Manager of the Mengel Co., operations at Laurel, Miss.

Coordinating the development of new products in the building, paper and chemical fields will be Dr. Hess' function. He will also work with the production and sales departments of Georgia-Pacific, to bring about more profitable utilization of wood fiber.

Alabama Firm Named Sawmill Equipment Distributor

Soderhamn Machine Manufacturing Co., Talladega, Ala., recently announced that they have acquired the sole distributorship of machinery manufactured by Mater Machine Works for Alabama, Arkansas, Mississippi, Kentucky, Louisiana, Tennessee, Texas, and Oklahoma. Soderhamn will also furnish service and spare parts.

Mater machinery to be distributed will include carriages, headblocks and knees, air dog conversion kits, frames, wheel trucks, setworks, log turners, saw guides and husks, trimmers, and Mater–Berry hydraulic carriage feeds. Other Mater items will also be available.

Small Homes Council Receives Research Grant

A research grant of $17,425 for continuation of the Small Homes Council's studies on building components has been given to the University of Illinois by the Lumber Dealers Research Council, it was announced recently. Emphasis of the one-year study will be placed on development of an improved roof framing system based on pre-assembled panels.

Factors to be included in the study are: structural design of roof components and the effects of limitations imposed on them by building codes, the relation of roof components to walls or other supporting members, assembly techniques, the effect of materials on assembly time and total cost, transportation problems, and the handling of the components in the shop and at the site.

Timber Engineering Co. Trains Six Award Winners

Six high-ranking forestry school graduates, winners of the lumber industry's 1957 scholarships, are receiving special training at the laboratory of Timber Engineering Co., research affiliate of the National Lumber Manufacturers Association, according to N. V. Poletika, director of research.

Selected from students nominated by 13 of the country's leading forestry schools, the recipients were chosen on the basis of their scholastic records, aptitudes, interests and extra-curricular activities.

The winners are: William H. Hunt, Colorado A. & M. College, Fort Collins; Roger F. Sutton, Yale University, New Haven, Conn.; John S. Fujii, University of Washington, Seattle; Marvin F. Bengelsdorf, University of Michigan, Ann Arbor; Charles C. DeRidder, Michigan State University, East Lansing; and David A. Strause, Oregon State College, Corvallis.

This is the eighth consecutive year of the lumber industry's scholarship awards, given to encourage forestry school students to prepare for and seek employment in private wood industries. In addition to the training each student received a $500 cash award.

Forest Product Lab Prepares Wood Identification Handbook

The age-old problem of identifying different kinds of wood is simplified by a new handbook prepared at the U. S. Forest Products Laboratory, Madison, Wisconsin and published by the Forest Service, U. S. Department of Agriculture.

The book entitled "Wood: Colors and Kinds", contains full-color, natural-size photographs of 32 common United States woods widely used for building construction, furniture, toys, novelties, containers, and hundreds of other items. Non technical descriptions tell how to distinguish each species by color, grain markings, and other characteristics seen in the photographs.

The Forest Products Laboratory prepared the book especially for builders, lumber dealers, teachers, students, home-workshop operators, and others untrained in professional wood identifying techniques. Dr. B. Francis Kukachka, in charge of wood identification services at the Laboratory, selected the more than 60 species and prepared the descriptions.

The handbook is available for 50 cents as Agricultural Handbook 101 from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

U. S. Plywood Dedicates New Research Facility

The creation of new materials and new combinations of materials for tomorrow's buildings was the mission given a newly-opened research center by J. W. Antoville, president of U. S. Plywood Corp. Mr. Antoville officially designated the new facilities as the Lawrence Ottinger Research Center in honor of the corporation's late founder.

Charles B. Hemming, the firm's director of research and development, will head the new center located on a 22-acre tract at Brewster, N. Y. The new products development division of the center will be directed by Vernon F. Sears, who will maintain liaison between the center and the company's 36 manufacturing plants.

Chemistry, physics, structural, and testing laboratories are major divisions of the center. In the latter a "rainmaker" cabinet will be used to test new products for effects from all sorts of weather conditions. A "warpcycle tester", a device perfected by Mr. Hemming, will be used to test the dimensional stability of new panel products. This tester works by a combination of chilled water and infrared lamps that produce differentials in temperature.

In addition to its manufacturing facilities, U. S. Plywood operates more than 100 warehouse-distribution units throughout the United States and Eastern Canada. Its annual gross sales approximate $200 million.

Mechanically Packaged Lumber Aim of NLMA and NRLDA Program

A program to develop methods of packaging lumber at the sawmill so it can be loaded and unloaded by completely mechanical means was launched recently by the National Lumber Manufacturers Association and the National Retail Lumber Dealers Association.

Mortimer B. Doyle, executive vice president of NLMA, said that this could "cut the handling costs of both retailers and manufacturers and, at the same time, reduce the damage sustained by lumber and wood products during shipment."

Sawmills cooperating in the program will send shipments of packaged lumber to retail dealers and distributors throughout the country for an eight-to-ten month period. Special committees of the NLMA and NRLDA will review results of the test shipments to determine the most efficient methods of packaging and mechanical handling.

A portion of the research center newly opened by United States Plywood Corporation at Brewster, N. Y., where new materials and combinations of materials will be developed.

Oregon Initiates Program to Utilize Wood Residues

Oregon has launched a program to convert its wood residues into payrolls, jobs, and industrial opportunities. To assist the state in its survey of potential raw material supply and to bring about greater utilization of wood residues, the Oregon Development Commission has hired Sandwell and Co., consulting engineers.

The Sandwell report, recently released, estimates that the potential annual raw material supply is approximately 900,000 bone dry tons of wood chips, or 450,000 air dry tons of chemical fiber for paper-making. The firm found three areas which are particularly suitable for wood composition board industries and picked nine other sites with basic factors conducive to the establishment of pulp and paper industries.

According to ODC Chairman J. W. Smith, if the raw material potential is fully utilized, it would represent a 60 per cent increase in the present use of wood residues. Translated into jobs and payrolls, it could mean an increase of approximately 3100 jobs and $15 million in payrolls.

Cumberland Corp. Opens New Distillation Plant

A three-million-dollar wood distillation plant for the processing of hardwood timber, owned and operated by the Cumberland Corp., Lexington, Ky., was opened recently at Burnside, Ky.

The plant will produce charcoal briquets, and develop production of furfural. It is reported that the output of charcoal briquets from the Burnside plant is expected to reach 30,000 tons annually, slightly more than 20 per cent of the estimated total U. S. production for 1957. A version of the 30-year-old Stafford process utilizing a high-temperature, two-retort system will be used in the manufacture of the briquets.

Distributor Named for Lumber Cure Compound

Distribution of their "Lumber Cure" compound in the United States is being handled exclusively by R. T. Vanderbilt, New York lumber chemical supply company, it has been announced by Morton Salt Co., 120 S. LaSalle St., Chicago. Under the new contract agreement, Morton will continue to manufacture the salt-based chemical compound, used in lumber drying, for the Vanderbilt Co.

Charcoal Production Methods, Markets, Theme of Conference

Charcoal Production and Uses is the subject of a conference sponsored by the Northeastern Wood Utilization Council, November 20, with headquarters at the auditorium of the Connecticut Agricultural Experiment Station, New Haven, Conn.

Developments in charcoal production methods and markets since the last conference in 1951 will be covered. Discussion sessions, presentation of papers and open-house visits to a number of nearby charcoal production facilities, including a new briquetting plant, will comprise the conference. Fred C. Simmons, Vice President of the Council is in charge of the program.

Papers will be presented on: charcoal production in the U. S. during 1955 and 1956; experience reports by beehive-kiln operators and on cinder-block kiln operation; new developments in cinder-block kilns; charcoal briquetting; and marketing of charcoal. Prof. Joseph Risi, Laval University, Quebec, Canada, will give a paper about charcoal production in brick beehive kilns.

Information on the conference can be obtained from Henry W. Hicock, secretary-treasurer, Northeastern Wood Utilization Council, P. O. Box 1577, New Haven, Conn.

NAMES IN THE NEWS

Named forestry adviser for the Philippines Forest Products Laboratory for six months was **F. F. Wangaard,** professor of lumbering at Yale University. Following service in the Philippines, Dr. Wangaard will go to Oslo, Norway, under a Fulbright grant to conduct research at the University of Oslo and Norwegian Institute of Technology.

Appointment of **Dan Griffith** as Northeast representative of Standard Dry Kiln Co., Indianapolis, has been announced. He will live in Cortland, N. Y., and service the New York and Pennsylvania territory.

D. GRIFFIN

A. STAUBER

Alvin Stauber, Yates-American Machine Co., Beloit, Wis., has been appointed sales manager of the heavy woodworking division. Mr. Stauber will supervise three company branches located in Portland, Ore., Memphis, Tenn., and High Point, N. C.

L. A. Patronsky has been named product development engineer for Pack River Tree Farm Products, Spokane, Wash., and affiliated lumber manufacturers in Idaho, Montana, and British Columbia. Chairman of the FPRS Wood Machining Division, Patronsky was on the faculty of University of Michigan for 14 years and for the past four years has been director of product development for Wabash Screen Door Co., Minneapolis.

Two graduate wood technologists have joined the staff of Timber Engineering Co. They are **Sheldon Greene**, graduate of Yale University, School of Forestry and **Nicholas Engalichev**, graduate from N. Y. State College of Forestry.

The appointment of **H. R. Dix** as manager of the lumber department of the Anaconda Copper Co. has been announced by C. H. Steele, vice-president in charge of Anaconda's western operations. Mr. Dix replaces **H. F. Root**, who retired August 1. Both Mr. Root and Mr. Dix are FPRS members; Mr. Dix is a past officer of the Inland Empire Section.

Deluxe Saw & Tool Co., Louisville, Ky., announced the appointment of **Frederick J. Keller** as director of sales. **N. C. Campbell** succeeds Mr. Keller as sales manager.

W. L. Irwin, FPRS Southeastern Regional Board Member is taking a ten-week executive refresher course at MIT, Boston, Mass., beginning September 30.

Promoted to leader of the Southern Appalachian Research Center is **Robert A. Campbell**, Southeastern Forest Experiment Sta., Asheville, N. C. He will be in charge of forest research at Bent Creek Experimental Forest and most of the federal research on hardwoods in the southern Appalachians. He succeeds **James F. Renshaw**, who is moving from Asheville to a position with the Forest Service in Atlanta.

Two sales department promotions have been announced by the G. M. Diehl Machine Works, Inc., Wabash, Ind. **William T. Bramlett** has been promoted to sales manager. **Richard G. Harrington** succeeds him as assistant sales manager.

Robert G. Redmayne, inventor of the Redmayne Veneer Tenderizer, has joined the staff of the Cardwell Machine Co., Richmond, Va. He will specialize in the development and sales of woodworking machinery for Cardwell.

W. T. BRAMLETT

R. G. REDMAYNE

R. W. Wellwood, Pacific North West Section Chairman, will be visiting in Australia and New Zealand, until October 21.

NEW PUBLICATIONS

Canadian Woods, their Properties and Uses. An Encyclopaedia for the Forest Industry. Includes principal statistics of logging operations as well as pulp and paper industry, wood measurement, definitions of terms used in pulp and paper manufacture; descriptions of characteristics and range of principal pulp species; structure of wood, wood seasoning, decays in pulpwood and their control, chemical composition of wood and bark of various species. Replaces 1935 edition of same title, issued by Forest Products Laboratories of Canada. Available from Supervisor of Government Publications, Queen's Printer, Ottawa, Ontario, Canada. Price: $3.00.

List of Publications of Forest Products Laboratories of Canada, Ottawa and Vancouver. Revised, October, 1956. List includes printed publications, mimeographed reports and reprints of articles and papers. Available from Forest Products Laboratory, Dept. of Northern Affairs and National Resources, Ottawa Ontario.

Growth—the Mirror of Progress. Anniversary booklet describing research work at the Timber Engineering Co., 1319 18th Street, N. W., Washington 6, D. C.

Standardization Aspects of Air Pollution Control. F. Y. Speight, ASTM, and F. S. Mallette, Resources Research, Inc. Summarizes work in the U. S. on standardizing terminology, sampling, and analysis procedures. Available from ASTM 1916 Race St., Philadelphia 3, Pa. Reprint from Industrial and Engineering Chemistry, Vol. 48, Page 69-A September, 1956.

Laminated Timber. Gives detailed description of timber laminating processes as carried out by four representative American firms, and contains sections intended to be a practical guide to a firm wishing to set up timber laminating plant in Europe. Available from O.E.E.C. Mission, Publications Office, 2000 P. Street, N. W., Washington 6, D. C. Price: $1.00.

Industrial Use of Wood-Waste. Reviews European approach to use of coppice wood, small sizes and fellings, slabs, shavings and sawdust, carbonization and distillation, wood chip and cement parpens, cellulose and paper pulp. Available from O.E.E.C. Mission, Publications Office, 2000 P. Street, N. W., Washington 6, D. C. Price: $1.00.

Increase Your Profit in the Woods. R. A. Whitmore, Jr., and W. L. Jackson. Reports results of a study made to find out how much timber operator's profits could be increased by proper application of log grades when bucking, and by more complete utilization of the merchantable stem. Central States Forest Experiment Station 111 Old Federal Building, Columbus 15, Ohio.

The Distribution and Volume of Hickory Timber. J. W. Cruikshank and J. F. McCormack. Hickory Task Force Report No. 5, Southeastern Forest Experiment Station, Asheville, N. C.

Buying Pulpwood by Weight as Compared with Volume Measure. M.

A. Texas. Station Paper No. 74, Southeastern Forest Experiment Station, Asheville, N. C.

Weight Loss by Fuel Moisture Sticks from Weathering. R. M. Nelson. Describes procedure to check stick weathering. Research Note 100. Southeastern Forest Experiment Station, Asheville, N. C.

Extent of Moist Sites in the Georgia Piedmont and Their Forest Associations. T. C. Nelson, R. D. Ross and G. D. Walker. Research Note 102. Southeastern Forest Experiment Station, Asheville, N. C.

Variation Throughout the Year in Moisture Content of Some Wooden Building Components. E. Brooks. Forest Products Laboratories of Canada, Department of Northern Affairs and National Resources, Ottawa, Ontario. Reprint from Timber of Canada.

The **Installation of Wood Block Finish Flooring by Adhesive Bonding.** $1.50. Building Research Institute, 2101 Constitution Ave., Washington 25, D. C.

Better Construction with Threaded Nails. E. G. Stern. Bull. No. 25. Virginia Polytechnic Institute, Wood Research Laboratory, Blacksburg, Virginia.

Production and Use of Wood Chips from Virginia Pine Thinnings. Station Paper No. 80, Northeastern Forest Experiment Station, Upper Darby, Pa.

Growth of Slash Pine Plantations on the George Walton Experimental Forest. F. A. Bennett. Station Paper No. 66, Southeastern Forest Experiment Station, Asheville, N. C.

Hardwood Timber Resources in Central and Northern Georgia. R. W. Larson. Station Paper No. 70, Southeastern Forest Experiment Station, Asheville, N. C.

Growth of Underplanted Hardwoods in Black Locust and Shortleaf Pine Plantations. Station Note No. 94, Central States Forest Experiment Station, Columbus, Ohio.

The **following publications are available without charge from the U. S. Forest Products Laboratory, Madison, Wis.**

List of Publications July 1 to December 31, 1956.

List of Publications on Glue, Glued Products, and Veneer. No. 515.

Lodgepole Pine. D. A. Zischke. Describes the range and character of growth of lodgepole pine *(Pinus contorta* Dougl.) and presents data on supply and production, physical properties and principal uses. Report No. 20[illegible].

Semichemical Pulping Characteristics of Pacific Coast Red Alder, Douglas-Fir, Western Redcedar, and Western Hemlock. E. L. Keller, J. S. Martin, and R. M. Kingsbury. Report No. 1912 (revised).

Factors Affecting Strength and Design Principles of Glued Laminated Construction. A. D. Freas. Reviews data on factors that affect strength and describes the design principles derived from them. Report No. 2061.

Durability of Water-Resistant Woodworking Glues. Reports results of Laboratory tests on the durability of various glues under various conditions of temperature and relative humidity. Report No. 1530 (revised).

Effect of Growth Zone on Specific Gravity and Percentage of Summerwood in Wide-Ringed Douglas-Fir. D. M. Smith. Presents data to show that the linear correlation between specific gravity of the individual annual rings and the percentage of summerwood in the rings does not change regardless of the zone of origin within the tree.

Wood and Fiber Structure by Incident Fluorescence Microscopy. R. O. Marts. Reprint from Journal of the Biological Photographic Association.

Paints for Exterior Wood Surfaces. D. F. Laughnan.

Testing Hardboard for Machinability. E. M. Davis. Reprint from the Wood-Worker.

Research Means Better Houses. R. F. Luxford.

Effect of Bark in the Sulphate Pulping of a Northern Oak Mixture. K. J. Brown. Reprint from Tappi.

Encyclopedia of Chemical Technology. Vol. 15, Waxes to Zymosterol and Index to all volumes. Reprint from Encyclopedia of Chemical Technology.

New—Fast—Continuous — Cold Soda Hardwood Pulping Process. K. J. Brown and R. D. Hilton. Reprint from Paper Trade Journal.

W-Type Roof Trusses—Why Are They Better Than Joist-and-Rafter Framing? Reprint from Wood Construction and Building Materialist.

Tension Test Methods for Wood, Wood-Base Materials, and Sandwich Constructions. L. J. Markwardt and W. G. Youngquist. Presents a brief account of the standardization of test methods, outlines the progressive development of the present tests, and gives some of the experimental data on which these developments are based. Report No. 2055.

Specific Gravity of Populus Species and Hybrids. B. H. Paul. Presents data on the specific gravity and on the radial, tangential and length-wise shrinkage of *Populus* species and hybrids. Report No. 2060.

Making Log Cabins Endure. Presents information on prevention of decay in log cabins. Report No. 982 (revised).

FPRS Salutes . . .

Men Contributing Time and Efforts for Furtherance of the Society and Wood Industry

M. B. CHRISTIAN

Moss B. Christian—Seven years of service on the FPRS executive board came to a close for Moss at the National Meeting in Buffalo as he stepped down as immediate past president. Moss served as South Central Region board member from 1949 to 1952, president-elect '54–'55, president '55–'56 and past president '56–57. Moss also was general chairman for the '53 National Meeting at Memphis and program chairman for the '55 conclave at Seattle. His term as president was highlighted by membership passing the 3,000-mark, the JOURNAL going on a monthly publication schedule, and a record total of 23 meetings held, including the first regional meeting at Chicago. Moss is co-holder of several patents with his employer, the Chicago Mill and Lumber Co., Tallulah, La. His most notable achievement was the development of "Craveneer", kraft-paper covered veneer for packaging. The Society is fortunate that Moss's valuable experience won't be lost, as he has been appointed chairman of the nominating committee.

J. D. RITCHIE

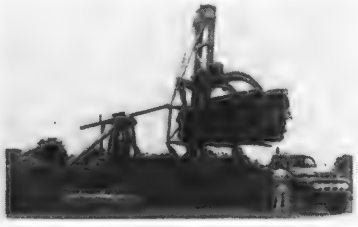
John D. Ritchie—The Society was "spawned" in the Pacific Northwest some dozen years ago, so it seems only natural that great things are to be expected from members in that area. This certainly has been true for the past three years with John handling the reins as Northwest board member. Under his guidance, Northwest membership jumped 34 per cent while Society membership was increasing per cent overall. His Pacific Northwest section enjoyed the greatest numerical growth of any of the 13 sections and his Inland Empire section the greatest percentage increase—up 56 per cent. John also served as general chairman for the highly successful 1955 National Meeting in his region at Seattle and his two sections sponsored a joint regional meeting at Lewiston, Idaho. A frequent contributor to the JOURNAL, John will continue to serve on the Veneer and Plywood Division. And well he should, for John is an authority on the subject. He has spent all his working life in the industry, and now is Allied Products Director for the Douglas Fir Plywood Association.

NEW PRODUCTS—LITERATURE

Electric Log Stacker

The 25-ton LeTourneau log stacker is proving to be an efficient log handling tool in the Southeast, according to R. G. LeTourneau, Inc., 2399 South MacArthur, Longview, Texas.

One mill operator reports that while formerly one log at a time was lifted by crane from a truck, scaled while in tow by the crane, then placed on a deck or truck to be carried to the mill, the new stacker is doing these jobs in less than half the time previously required. With the log stacker, an entire load is lifted in a single bite, carried to a decking area, and the logs rolled onto the ground so each log can be scaled individually.

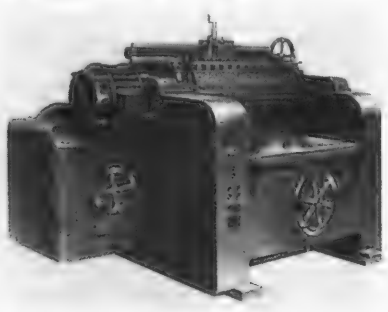


The stacker is equipped with extra-wide, low pressure tires and an infinite torque control electric wheel drive system. Diesel–electric powered throughout, the stacker has automatic-setting brakes on every motor which stop and hold capacity loads instantly whenever power is interrupted.

Single Surfacer

A new single surface planer, designed for heavy duty roughing work in conveyorized operations, has been released by the Buss Machine Works of Holland, Mich. It has lower roll control, semi-automatic pressure bar control, one-shot oiling system and chrome plated wearing surfaces on the center table and pressure bar.

The machine, it is reported, has been designed for immediate accessibility to all gears and moving parts by means of swinging guards and hinge arrangements to facilitate inspection and reduce down time. The machine has a cast steel sectional shipbreaker capable of an individual lift of 1½ inches on each section.



Dust Collector Bulletin

A fully illustrated folder on centrifugal collectors is now available on request from the Kirk & Blum Manufacturing Co., 3120 Forrer Street, Cincinnati 9, Ohio. Two new designs are described with a wide range of industrial applications in air cleaning and dust collection through centrifugal force. Information on collector selection through determination of particle size, etc., is presented.

[*Continued on page 35-A*]

EMPLOYMENT SERVICE

The FPRS Employment Service is operated without charge as a service to members. Companies or institutions with positions to be filled or individuals seeking employment may participate in this program by inserting a free ad in two consecutive issues of the FOREST PRODUCTS JOURNAL. Inquiries concerning employment listings or ads to be placed in the JOURNAL should be addressed to FPRS Employment Service, P. O. Box 2010, University Station, Madison 5, Wis. Correspondence is kept confidential.

Positions Offered

E-280—Graduate in wood utilization, age 25–35. To be assistant to general manager of mill making products from hard maple. Located in western Penn. Salary open. (August)

E-288—Wood technologist for final woodwork inspector desired in Chicago area. Experienced in finishes, colors and construction of high quality musical cabinets. Able to define, detect, train and supervise personnel. Age no barrier. Experience waived in lieu of formal schooling. (August)

E-289—Field representatives for West Coast plywood manufacturer needed in Central and Eastern states. Activities: promotion, sales, technical service with travel in broad territory. Will be responsible for developing successful plywood markets. Age: 25–35. Some sales or promotion experience desirable. (Sept.)

E-290—Experienced man for sales work sought by manufacturer of domestic face veneer. Will operate from home office in Midwest. Excellent opportunity to advance to sales management. Reply giving personal history. (Sept.)

Employment Wanted

No. 423—Management position desired. Mechanical and industrial design engineering education, age 37, married. Experience in furniture, cabinet, and show case mass production, including cost, time study, purchasing, labor, machine design, sales, etc. Prefer southern Calif. or northeast location. (August)

No. 424—Graduate in wood technology, age 39, married, desires position as plant manager. Experience as manager of production planning, general plant manager, technical salesman, research engineer in paper and plywood fields. (August)

No. 425—An M.S. Chemist with experience in large chemical research programs interested in creative position in chemical, wood products or mineral-related industry,—research, liaison or technical service. Has done work on physical chemistry, catalysis and rocket fields, supervised chemists and a pilot plant crew, with writing, speaking and contact experience. Available soon. Prefers New England, Northeast or North Central location. (Sept.)

No. 426—Graduate in wood utilization, age 28, single, with experience in wood treating, research and development desires position utilizing education and experience. Prefers employment in north. (August)

No. 427—B.S. in wood utilization and M.F. in wood technology and industrial engineering, age 30, married, desires position utilizing training and experience. Experience as industrial specialist, wood engineer, quality control supervisor. Will accept employment anywhere. (August)

No. 429—Graduate in forest products manufacturing seeks position in field of production, management, research or teaching. Prefers general production or research connected with forest products. Age 27, married, has M.S. from College of Forestry, Syracuse, N. Y. (August)

No. 430—Graduate in wood technology, age 29, single, desires position as wood technologist. Experience as wood technologist. Prefers Pacific Coast location. (August)

No. 431—Position as wood technologist, research or development desired. Age 29, married, with M.S. in wood utilization. Experience as wood technologist, research assistant, timber sales officer. Will accept employment anywhere. (August)

No. 432—October graduate in wood technology and statistics, desires position in production, research, sales, or management. Age, 25, single. (August)

No. 433—September graduate in wood technology and statistics would like job in research, production or teaching. Age 24, single. (August)

No. 434—Position desired as plant manager, engineer, or industrial engineer. Age 40, married. B.S. degrees from University of Idaho and University of Oklahoma. Experience as production engineer, plant engineer, chief project engineer, senior design engineer, chief draftsman. Will accept employment at any location. (August)

No. 435—November graduate in utilization and marketing desires position in sales, management, production, teaching, or research. Age 26. (August)

No. 438—Technician with 23 years experience will accept position in U. S. or foreign plywood company. Experienced in plywood and adhesive research, quality control, technical service, plywood manufacturing methods, machining, supervising, and familiar with processing and gluing of exotic woods. (Sept.)

No. 439—Responsible position desired requiring drive, initiative, and ability to obtain results. Experienced as plant manager, with 28 years comprehensive engineering and executive experience in fields of mechanical, electrical, chemical, constructional, civil engineering and particle board production. Prefers position in particle board industry. (Sept.)

No. 441—Person with 25 years of managerial experience desires position as assistant project manager or assistant plant manager of particle board plant. Masters Degree in law and economics from J. K. University, Lvov, Poland and 1 year of chemical engineering at Polytechnic Institute, Lvov, Poland. Will go any place in U. S. (Sept.)

FPRS Forest Products Journal

Vol. VII, No. 8
August, 1957

The Unexplored Facets of Wood in Home Construction[1]

CALEB HORNBOSTEL

Caleb Hornbostel, Architect, and Associates, New York, N. Y.

Using sheathing and wood beams as T-beams in exterior construction, combining rough flooring and the finish floor by using construction plywood for interior construction, and adapting many new wood uses in furnishing and decorating are among the possibilities cited for greater use of wood in home construction.

Introduction

THERE ARE MANY UNEXPLORED AREAS and processes in home building where the uses of wood never have been explored thoroughly.

The possibilities of where wood could be used can be broken down by following through from the excavation to the finished house—foundation, framing, exterior finish, interior finish, painting and decoration.

[1] Presented at Northeast Section Meeting, Oct. 25–26, in New York, N. Y.

The Author: Caleb Hornbostel is a graduate of Carnegie Institute of Technology and Ecole des Beaux Arts, Paris, France. He has taught architecture at four colleges and currently is an instructor at Cooper Union.

Framing

First the framing, or in other words, construction: The normal present-day methods of construction—post and lintel and light truss—are well known. (Figs. 1, 2) Taking the simple problems of post and lintel for a roof, the span is considered, the load figured, the size of the wood lintel or beam that will span this width and at what spacing is determined. If a simple beam cannot span it, a simple wood truss is used. Then it is covered with sheathing and finished with roofing material.

Immediately the question comes up, why isn't it possible to make the sheathing and the wood beam act as a T-beam? (Fig. 3) The sheathing and the beam would then become an integrated team working together instead of one merely lying in the other. This would mean the sizes of wood beams could be cut and wider spacing made.

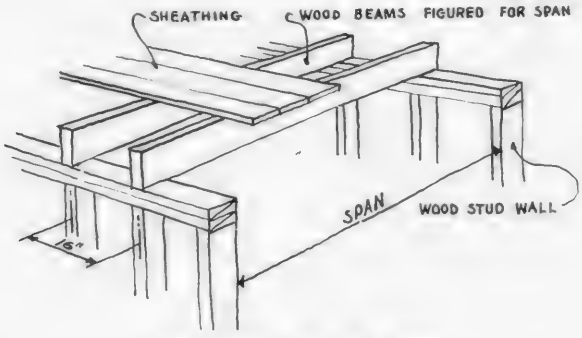


Fig. 1.—Simple post and beam.

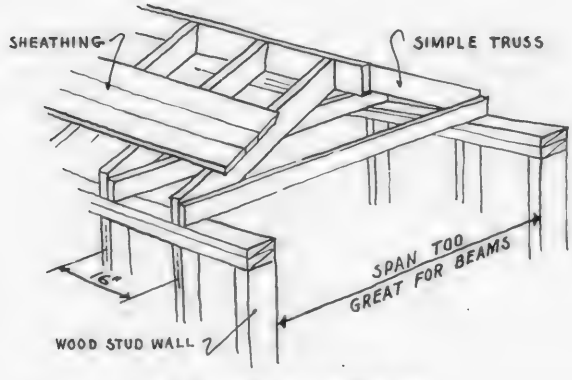


Fig. 2.—Simple post and truss.

Following this thought a little further, would it not be possible for lumber companies to create prefabricated wood T-sections for house construction? Or would it not be possible to give information about adhesives, whereby the normal roof beam and sheathing could be figured as a unit once glued together. (Fig. 4) Also this opens up the possibility of spanning much larger widths than are done today with a simple beam.

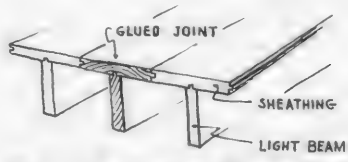


Fig. 3.—Sheathing and light plus light beam equals "T" beam.

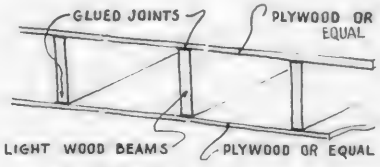


Fig. 4.—Pre-fabricated box beam.

Following this trend of thought, would it not also be possible to incorporate light stainless steel wires with wood, utilizing the wires to take the tension, following along the same principles used in concrete and prestressed concrete beams? (Fig. 5) Once again, new technological knowledge can be utilized to evolve new forms of wood beams which did not exist before.

Laminated Wood

At present, the whole field of laminated wood is just beginning to be explored for its use in residential construction. Digressing a moment, during the second World War many of the English airplanes, particularly the Mosquito bomber, were completely

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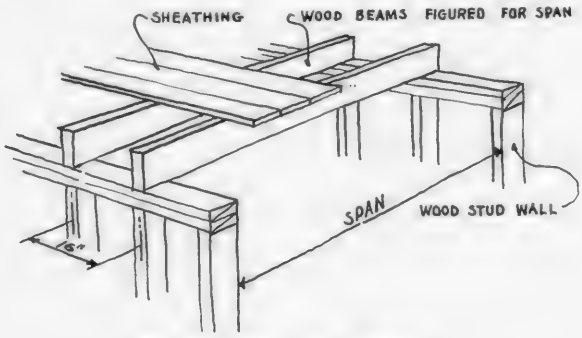

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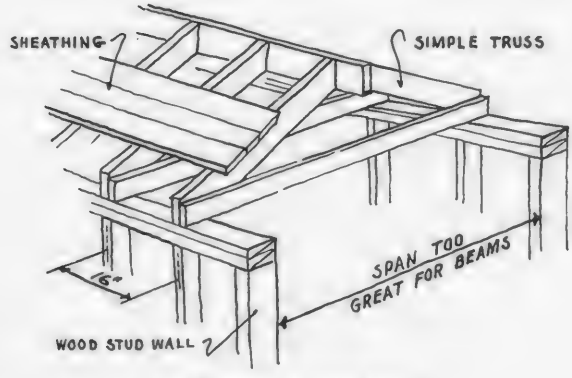

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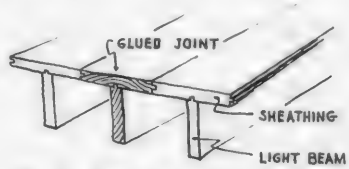

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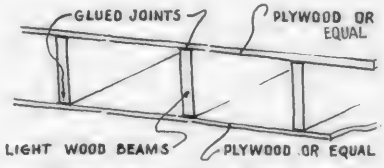

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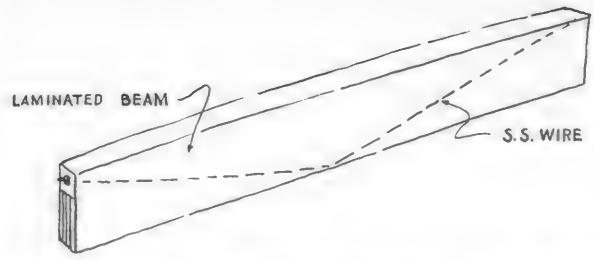

Fig. 5.—Laminated wood beam with pre-stressed stainless steel wire.

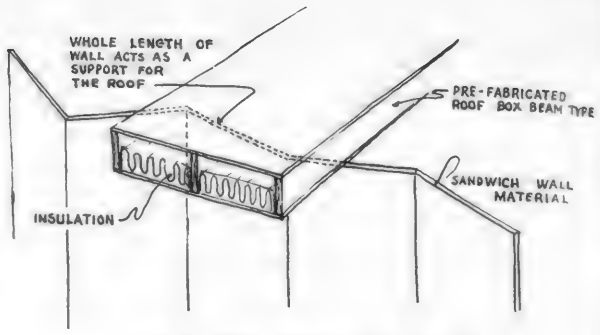

Fig. 8.—Wall itself is support for roof.

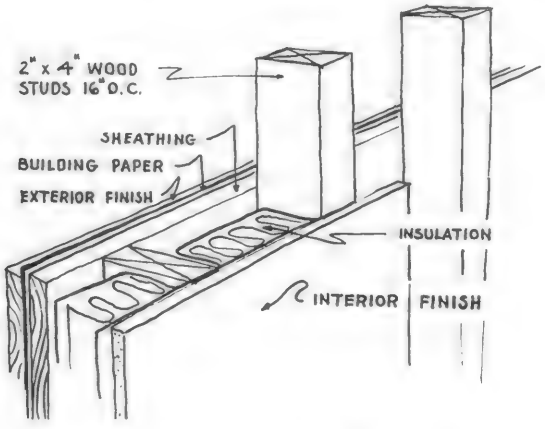

Fig. 6.—Current exterior wall construction.

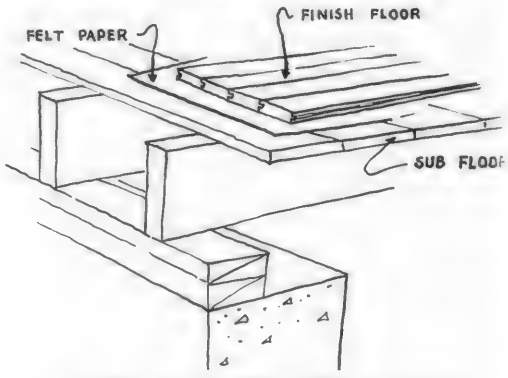

Fig. 9.—Current method of floor construction.

plywood jobs, opening a whole field of research for the use of laminated bent plywood shapes with which spans of up to 20, 30, and 40 ft. can be achieved.

The principle of the post and lintel as generally followed today is the use of a 2 x 4 vertical post set from 12 to 24 in. on center with wood lintels or light trusses spaced similarly. (Fig. 6) When the roof is considered as a continuous integrated unit instead of as a series of lintels, the vertical wall now becomes a continuous supporting member and not a series of posts.

Therefore, the vertical wall or exterior of homes could be treated as a plane where the roof load is supported by the whole length of the wall and not by individual posts. Therefore, these walls can be explored from an entirely new direction; they can be curved, warped, accordian pleated, or shaped to any other form that is a continuous plane.

Since the walls are considered as a plane, what can the walls be made of? The walls can be sandwich materials; wood, particularly plywood, could make a whole exterior wall about an inch thick. With the advances made in the new forms of insulation, these walls might be brought down to ½ in. thick. (Fig. 7)

Consider what is existing in today's fields along these lines. Plywoods have become both the sheathing and the exterior finish; also in some cases sandwich materials have been tried and used. The basic structure of the home becomes a series of manufactured elements assembled on the job, utilizing all the advanced technologies to make a building much simpler and easier to construct and utilizing the inherent strength of wood to its maximum abilities. (Fig. 8)

The whole field of wood in home construction as far as the structure is concerned is still tied down by archaic methods of building. There is a need to make use of the inherent advantages of wood and supplement them with other materials, thereby making a combination which has the advantages of both and the disadvantages of neither.

Flooring

Consider the rough flooring. Is there any reason why rough flooring and the finish floor cannot be one? (Fig. 9) It doesn't seem beyond the realm of possibility to take a 4 x 8 piece of construction plywood and have a thicker ply on one side, which could be the finished wood floor. (Fig. 10) Admittedly, this might raise some difficulties in construction, but these difficulties can be overcome. There may be a certain amount of difficulty in the fiber stresses in the plywood due to the heavier veneer on one side, but manufacturers can overcome these problems. (Fig. 11)

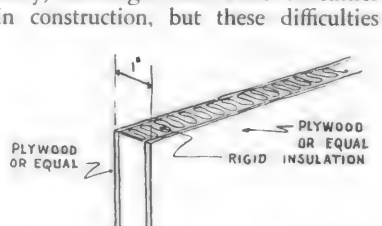

Fig. 7.—Pre-fabricated sandwich exterior wall.

These are only a few possibilities whereby new approaches to the use of wood will lead to greater uses and perhaps unexplored uses of wood in the basic construction of houses.

Interior

Bedroom: Surveying the interior of a house, approaching it room by room, starting with the bedroom: In contemporary architecture, usually one wall of a bedroom is now mostly glass. Another wall is usually either closets or built-ins, naturally of wood. The bed will be placed against one wall. There should be a backboard for the bed and night tables; the wall receives quite a bit of abuse. Here is a natural place to use wood. The fourth wall is in many cases either glass or, according to the design concept, either a contrasting material or, again, wood.

Why could not normal wood cedar shingles be used on the walls? In other words, why cannot many of the exterior materials be brought in and used on interior walls? Certainly if they are able to stand the rigors of weather, they should be able to take the beating of interior use. Where else can wood be used in this room? Why would it not be possible to make perforated plywood panels for the ceiling?

Bathroom: It has always been generally accepted that very little wood be used in the bathroom. A good many years ago a rather large summer house was designed which was located on an island and the problem of transportation of materials and labor was a critical one. In this particular case, all the bathrooms in the summer house had no tile, so nothing but wood cedar shingles on the walls were used with a very good protective coat of enamel paint. These bathrooms have been in operation for 16 years, and the curious thing about them is that there has never been any trouble between the shingles and the top of the bathtub.

Following this trend, why again would it not be possible to use in the bathroom many of the wood materials which are used on the exterior, where certainly they get the worst treatment possible?

Going back to the combination rough flooring and finish floor, certainly it should be possible to make a single piece of plywood to cover the entire floor area of the bathroom. (Figs. 10, 11) In this manner, since all joints are eliminated and the whole problem of warpage is eliminated, it seems perfectly reasonable that a good hardwood floor would be suitable for a bathroom.

You can buy molded plywood boats today. Would it not be possible to make wood bathtubs? Certainly this is a possibility that could be looked into. If plywood stands up in salt water, it certainly could take the rigors of bathing. The good old bathtub ring might even be lost in the wood grain.

It might be amusing to think about a teak bathtub, a mahogany john, and a birch lavatory. The interior decorators could really go to town! And this might bring back the nostalgia of the outhouse to the bathroom.

Kitchen: In the kitchen, with the advent of Spic 'n Span, wood has lost out, not in the cabinet but in counter tops, wall surfaces, etc. There would be great difficulty in trying to utilize wood for flooring or counter tops and wall surfaces because a terrific publicity campaign would have to be done in order to show that wood treated with special finishes would do the same job as other materials do today.

After all, there are many kitchens—particularly in many of the older residences—where the hardwood counter tops and walls are in fine shape and are doing the job even today. Here it would be up to the advertising and promotion people to overcome prejudice.

New Type Living Room: The living room and dining room will not be discussed but there is a tendency in the modern home which is growing by leaps and bounds due to two phenomena: one, television, and two, the automobile. These two completely unrelated products in our lives today have caused a very basic change in thinking about home living, that is, the problem of another room.

Years ago the parlor almost served the purpose of what is considered the living room today, and the family room in the terminology of today is in reality the living room of the past. This raises a new problem in home design, to which no definite answer has been given yet, except that a new room should be incorporated into the home.

Television makes it impossible to have only one living room because one member of the family wants to see a television program while another member of the family wants to do something else, such as read a book. And the automobile has made it possible for the young people to constantly visit one another, thereby shoving the father and mother out of the living room.

This means that a new room of some type or a new way of thinking about house planning is going to evolve. It is obvious that out of this problem will evolve two different types of rooms. What they will be is yet undecided, but it is obvious that one of them is going to be a more formal room in the broader sense of the word and therefore will almost automatically be treated with wood—bookcases, paneling, etc.—which will give it a secluded, quiet feeling. Here is a complete new cubic area which is going to enter into our homes of the future where wood will be a must for its finishes.

Surface Finishing

Perhaps the most unexplored area of wood use is surface finishing, not that the paint people are not doing a fantastic job, but this is a new question. With our advances in chemistry and the plastics field, it certainly seems that the beauty of wood—its graining, its coloring, and its texture—which all architects and decorators like to utilize, should not be covered with paint or some other protective material; the wood itself should be treated either on its surface or by impregnation in such a way that its beauty remains but its finished surface becomes as durable as anything on the market today.

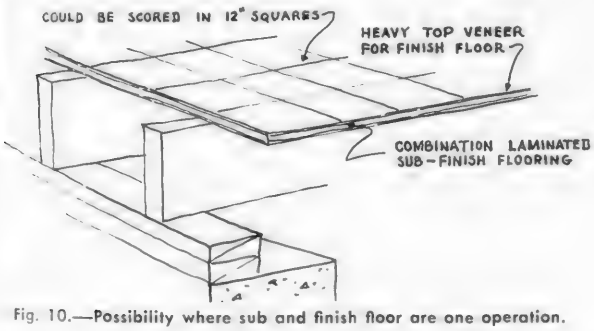

Fig. 10.—Possibility where sub and finish floor are one operation.

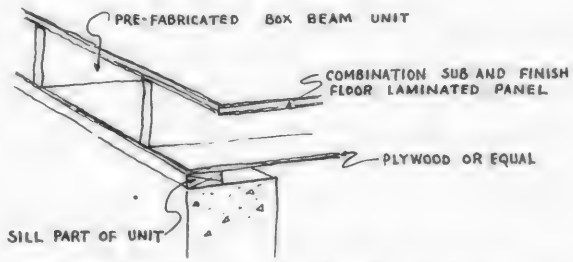

Fig. 11.—Possibility where entire finish floor, sub-floor, joists and sill done in one operation.

The Modular System of Home Construction and its Possible Effects on Furniture[1]

J. E. KINNEBREW
General Manager, Living Room Div., Simmons Co.

Coordination of planning of the home and furnishings into an integrated unit will result in greater utility and lower probable costs. Further standardization will enable a home buyer to add components based on modular standards similar to dimensions used in the construction initially.

Introduction

IN CONFERENCES JOINTLY SPONSORED by HOUSE & HOME magazine, the American Standards Association and the Research Institute of the National Association of Home Builders, agreement was reached on certain standard dimensions for house construction. It was suggested that it would be of constructive interest to have the comments of someone from the furniture industry on these developments.

The most recent of these conferences resulted in agreement on a 4 ft. module with even-foot fractional modules for bedrooms, living areas and built-ins, and a standard three-foot, four-inch width for bedroom halls. Previous conferences had produced standardization on the height of flat ceilings, standard window heights, standard door widths and a standard dimensional module for bathrooms.

This progressive step undoubtedly has considerable merit in its potential of reducing basic building costs. The primary interest this might have to the furniture industry is the hope that the home buyer has a little money left after building his home, to buy the furniture he will require. And the furniture salesman had better get his foot in that standardized dimensional door before an automobile salesman or some salesman selling European tours on a time payment plan gets what is left of the home buyer's credit.

The architectural considerations involved in this program have very little relationship with furniture dimensions. It is recognized that such consideration was not the objective of the program. However, the standard dimensions recommended have no apparent conflict with furniture designs.

Standard Furniture Dimensions

There are very few standardized dimensions in the furniture industry, other than vertical. Seat heights of chairs and sofas and heights of occasional tables, dining tables and chest of drawers have some aspect of standardization. Seat depth in upholstered furniture is held to standard dimension within reasonable tolerances. This is understandable, as they must serve a functional purpose in relationship to the average proportions of the human body. There is, of course, always a few in the design group seeking to be creative along these lines.

In bedding there is considerable standardization in the mattress sizes, such as the standard 3/3 twin size, 39 in. in width and the 4/6 full size, 54 in. in width. Despite the fact that these sizes are common knowledge, many homes are built with bedrooms that it is a Chinese puzzle to figure out which wall could be used for the headboard and still permit access thru the room.

It is along these lines that architectural consideration could serve a constructive purpose for home builders. There is no doubt that many architects do an excellent job of advising their clients regarding the ultimate furnishing plan of their house and it is equally as obvious that many home buyers give very little consideration to the furnishing plan prior to building. Functional planning should be one of the primary considerations.

Functional Planning

Consider the planning of a home. There are the basic functions of the kitchen, the bedroom, the bathroom, the dining area and the living room, and a relationship in the locations of each of these units. Then consider the function within each one of the rooms. The placement of the furniture, the amount of space required for movement and the practical consideration of living in such a room, even the consideration of providing pleasure from comfort, share importance with beauty of appearance.

Decorators face problems when presented a floor plan and being asked to make recommendations as to placement of sofas or chairs or other pieces of furniture. The two most common problems from this standpoint are inadequate planning for the placing of a sofa in a living room and the consideration of either a full size or a pair of twin beds in the bedroom.

Obviously, there is little difficulty from the standpoint of a dining room, nor is there as much difficulty with the kitchen, as housewives give considerably more attention to that room than other rooms in the house. And, fortunately, the architects and the builders are familiar enough with the required furnishings in a bathroom.

It appears that one of the most critical problems to the home buyer is to obtain adequate housing commensurate with his ability to pay. The physical size of a house in its relationship to the requirements of a family from the standpoint of accommodations and comfortable living should, in my opinion, be of the utmost importance to the home buyer. This does not necessarily mean that the size of the house nor the size of rooms are the most critical consideration.

Also, consider the advantages that functional planning would have in providing a more livable home because of increased utilization of space and the minimizing of wasted space. Not only is the home buyer involved in the initial cost of providing such waste space, but later with the cost of heat, light and maintenance. Improper placement of openings such as windows and doors, inadequate planning of furnishings, and insufficient study of individual room function all contribute substantially to space loss in a house.

Economic Consideration

In the recent magazine article about the conferences on standardization and dimensions, one of the participants said, to the effect, that an increased amount of built-ins would be desirable. It is this area of research that architects could make a worthwhile contribution to the potential of closer integration with the furniture industry.

[1] Presented at the Midwest Section Meeting, May 2–3, 1956, in Dubuque, Iowa.

It is also along these lines that the architectural profession could increase the use of its services to small home builders and establish the value of those services to a wider consuming public. It seems that despite the extent of home building, residential design is not as attractive to most architects as other types of building.

It appears that there has been an increased effort on the part of the home builders to add more and more additional components to the package the buyer is offered. It is true in most instances that the equipment included is desirable. However, consider the parallel of automobile manufacturers loading accessories on an automobile. This trend should be studied carefully by all responsible people in the home construction field. It is recognized that this practice is attractive to home buyers with limited finances because the cost of such equipment will be included in a long term obligation.

There can be no question of the necessity for the large volume of home building that is currently in progress and no issue taken with the credit program that makes it possible for the average wage earner to purchase a new home, but the nature of the investment could stand some re-examination. If houses were reduced even a small percent in cost by the standardization of dimensions that were recommended, this would be a gain primarily through an elimination of waste and certainly should be recognized for its importance to home buyers.

In addition, if standardized dimensions would permit installations of components in later years the entire economical aspect of home construction would be on a sounder basis. In other words, instead of loading the home buyer and extending his obligation, there would be a great deal of merit in giving him a better *basic* house that would provide for his present requirements and possibly for his growing family in the future.

Standard Components Parts

To be able to accomplish this type of program standardized modules would be of the utmost importance. This would be necessary in order that installation of components at a later date would not incur increased costs.

For an example, if initially a room area was sufficient in size to provide later for a non-structural designed wall, and such a design included closets for each of the two rooms created, a certain amount of initial interior cost would be eliminated, *although* offset by the additional size of the rooms involved. Non-structural walls could be added, if necessary, to adapt the arrangement of house to the changing conditions of a growing family.

Other considerations would be the initial installation of a basic kitchen that could be expanded with increased cabinets and counter space as necessity developed. Extensive research and development is being conducted toward this type of architectural objective, and is a definite constructive trend in home building; the planning that has provided carports that could ultimately be converted to garages and areas for recreation rooms that could be completed later. It appears also as a means for providing a stabilizing effect on an industry whose facilities are obviously overloaded at the present time.

House construction on a boom basis can only result in less value to home buyers. A program that will provide a sound means to extend this demand over a period of years and provide a sustained market, will be to the advantage of everyone associated with home construction.

Summary

In summary, consider this hypothetical development. A home is offered to Mr. and Mrs. Homemaker. They have two young children and possibly will have an additional member to their family. They buy a home that has a professionally designed exterior, that has had professional consideration of its room plan with consideration of room function and furnishings, and Mr. and Mrs. Homemaker have received the maximum house they can afford to buy stripped of non-essential components.

It is recognized that they have incurred a long term obligation, but they have also obtained housing that will provide them long term utilization. Now, as Mr. Homemaker might progress in business they have an opportunity to go to a retail store that could quite likely be a department of a building and supply company, where they have an opportunity to shop competitively for components that they can install in their home. Such components having been produced on modular standards similar to dimensions that had been used in the construction of their house initially.

We all know that competition is conducive to providing the best value of a product to the consuming public, but the public must also have the ability to make price comparisons. It is doubtful that most home buyers in the purchase of a home have any concept of the cost of individual components included as a part of the price they are paying, and it is questionable that the prices if they were known could be considered to be on a competitive plane.

Architectural units manufactured on a production basis would assuredly be at a lower cost than such that prevail generally in home construction today. Detailed mill work is still, in a large degree, a custom shop order type of manufactured item.

Home builders should be more concerned with construction as such and less involved in the sale of appliances and accessories; that architects should have increased opportunities for their talents, as professionally designed components could be merchandised with emphasis on the designer's skill. Such a designer would most likely be an architect because of the integrated standards required for both the components and the initial house plan.

Conclusion

Cooperative research on standard dimensions and modules in relation to furniture design would produce a more practical furnished home than is being offered currently. Industry conferences such as were sponsored to establish standardized dimensions, and assistance from architects and contractors by providing more consideration of the home and its ultimate furnishings as a single integrated unit, will result in better living for tomorrow's home buyer.

The Modular System of Home Construction—Its Possible Effects on Millwork[1]

WAYNE A. NORMAN

Production Division Manager, Carr, Adams & Collier Co., Dubuque, Iowa.

Does the maze of more than 1,500 window sizes offer any advantages to the building industry? The manufacturer, the architect and the builder say no. Representatives have recommended that if windows, doors and cabinets were standardized it would be easier to design and build homes—at less cost to the home owner.

Introduction

IN TALKING ABOUT a modular system of home construction, it first should be mentioned that the modular system is not new. The American Standards Association organized Project A 62 nearly 17 years ago. This project set up the standard 4-inch modular unit. The National Woodwork Manufacturers Association, working on this base, pioneered the 4-inch module for millwork products.

Wood double-hung window units, which at that time were made in ten regional window standards of a couple hundred sizes per standard, were reduced to one standard based on the 4-inch module. Although present standard sizes for double-hung wood windows show some 100 sizes, some 16 sizes constitute 90 per cent of the use.

Newer type window units such as the awning window have been introduced in a much reduced schedule of sizes. We offer this unit in three heights and four widths for a total of 12 basic sizes.

Thus, modular coordination is not something radically new and some definite progress has been made toward modular coordination by the millwork industry. Admittedly, much is yet to be done, particularly in coordinating between groups of manufacturers and possibly in increasing the size of the modular units up to 12, 16, or possibly 24 inches.

Recognizing the need for further action, HOUSE & HOME magazine, in cooperation with the American Standards Association and the Research Institute of the National Association of Home Builders, arranged a series of round tables to discuss modular coordination. The principal goal was to reduce building costs by a step to a larger module than the 4-inch module and to promote a more uniform understanding between groups. These round tables were attended by representatives of all segments of the building industry.

[1] Presented at the Midwest Section Meeting, May 2–3, 1956, in Dubuque, Iowa.

The Author: Wayne A. Norman received a degree in architectural engineering from Iowa State College. He served as a research and development engineer at the Army Air Corps Material Command during World War II. He joined Carr, Adams & Collier in 1946; was elected treasurer in 1952, and to his present position in 1955.

Accomplishments

The first of these round tables accomplished four things: It brought into the open the fact that after 20 years of talking about standard dimensions, the building industry didn't agree on a standard terminology of measurement. It is now official that a house 26–0 wide is 26–0 wide from the outside face of the stud to the outside face of the stud.

Dimensional standardization and coordination for the builder's house must start with a standard ceiling height, because ceiling height affects the size of all components and subassemblies for every part of the house, inside and out. It was agreed unanimously to urge the 8–0 plus a tolerance standard ceiling height jointly recommended five years ago by the design committee of the National Association of Home Builders and the Home Building Committee of the American Institute of Architects.

An agenda was outlined for a succession of other round tables to propose standard dimensions for specific parts of the house: one to propose standards for the door and window openings in the outside wall, one to propose standard dimensions for the bath, one to propose standard dimensions for the kitchen, one to propose standard dimensions for the other rooms of the house.

Finally, a statement of policy was agreed upon:

1. "All builders' houses, where good performance, good appearance, and low cost are alike important, should, conform in certain respects to standard and coordinated dimensions, so that various stock components and subassemblies can be produced in few enough sizes and big enough quantities to permit the great savings of concentrated volume production.

2. Manufacturers should encourage this advance toward industrialization by quoting substantially lower prices on these standard sizes, so that each individual builder and his architect will have an immediate profit incentive to cooperate in the standardization program."

This all adds up to a uniform and specific standard measurement both horizontally and vertically for the shell into which windows, doors, and cabinets must fit.

Multiple Sizes Costly

The round tables on windows found that metal window manufacturers now catalog some 750 sizes, and the wood manufacturers catalog about the same number more. The manufacturers and their distributors said that making all these sizes and distributing them was costly, that they had to make the sizes the architects and the builders ordered, to which the architects and builders replied:

"All these sizes offer little advantage to the architect. On the contrary, they make it harder for him to line up a single coherent design."

"All these odd sizes are no help to the builder. On the contrary, they make it hard for him to dimension any other wall component until the windows have first been chosen and bought."

Instead of the 1,000 or more present sizes, the architects and builders said they would much rather have about 18 sizes to work with, but they wanted those 18 sizes to fit the sizes of other components of the wall. They wanted them to fit the stud space. They wanted them to fit the sheathing and insulation. They wanted them to fit the dry wall. They wanted them to line up with the door heights.

They wanted one standard 3–0 window height for bedrooms and bathrooms, rooms where you want to see out when you stand up, but you don't want everybody to look in. They wanted one 4–0 standard window height for the living room and the dining room—rooms where you want to be able to look out when you're sitting down. They wanted one standard 6–0 window height for picture windows—

allowing room to run wires and baseboard heat under the window and room for header above.

They wanted those three heights in six widths ranging from 24 up to 96 inches—(24, 32, 48, 64, 80, and 96 inches). Window widths would conform to a 16-inch module which is the normal stud spacing; however, since 24-inch stud spacing for one-story houses is usually considered adequate, a 24-inch width was included.

Relation to Available Units

Now the question is, "How do these sizes stack up with standard units now available?" Well, they don't stack up. Present wood double-hung, casement, and awning or projected unit sizes do not fit into these openings. Neither do present metal window sizes. The present concept of window design involving combinations of single units into multiple units, both horizontally and vertically, is not compatible with these new openings because of the problem of rough openings between studs. In other words, the two 48-inch units do not make a very acceptable 96-inch because of the omitted stud space which must be filled. Present sizes and the present design concept of combining singles into multiples will not meet these requirements.

So it would appear that a new line of units must be prefabricated to fit each width rather than units combined to width. This is a major change and brings up one of these chicken and egg problems as far as the customer acceptance is concerned.

To summarize on the window proposal, two problems must be analyzed:

First, the industry has found ready acceptance to the principle of combining single units into multiples both vertically and horizontally. This has offered a considerable degree of flexibility out of a relatively few sizes. It is allowing originality without anarchy. The proposed new size approach would probably involve complete units for each size, thus reducing the flexibility of combination. "What is our boss, the customer, going to say about that?"

Secondly, let's not be fooled by the small number of sizes. A new type of window unit was offered two years ago in only 12 basic sizes. The line has been held very well on these sizes through the fine cooperation of millwork jobbers. However, to satisfy the customer, who again is the real boss, three types of each operating unit glazed in two ways (single strength glass and insulating glass were needed. To satisfy the market six types of each size or a total of 72 types, still only in 12 sizes, were needed.

So 18 sizes probably does not mean only 18 different window units but probably several times 10 to keep our American customer happy.

Doors, Kitchen Cabinets

Door recommendations boil down to two basic heights, 6–8 and 7–0, which are already standard door sizes. In fact, exterior front doors have become so standardized that on new designs one size, 3–0 x 6–8 may be offered. So there would appear to be no problem here. The opinion was expressed that the 7–0 door height would be preferred over the 6–8 height now popular due to FHA minimum requirements.

Kitchen cabinet recommendations indicated a standardization on a 24-inch module along the wall, a 24-inch base cabinet depth, and upper cabinets running clear to the 8–0 ceiling. This fits into both the three and four-inch modules now current in the industry and would appear to cause no problems. It would certainly be a major reduction in sizes since most cabinets are now offered in at least 10 to 12 different widths and this would theoretically narrow it down to one 12-inch width.

A 24-inch module will be a real advantage in new housing when architects and builders in majority adopt 24 and 48-inch module for all room sizes. Repair and remodeling constitute a major market for cabinets, and it is in this market that the present number of widths will be required for some time to come.

Conclusion

The principal millwork manufacturers stand ready to cooperate as they have in the past in standardization and coordination of the building components. It is rather obvious that with such major revisions as will be necessary in the window field, the change will have to be gradual. In other words, you can say that it will be *evolution* rather than *revolution*.

It would seem quite definite that this evolution will be in the direction of larger prefabricated sections from a 4-inch module to a 16-inch module as the next step, and, possibly, then on up to a 48-inch module. Thus the units would approximate those now used in prefabricated housing but would provide much more flexibility of combination.

The millwork industry must improve its ability to anticipate what tomorrow's progressive builders are going to require in order to meet and expand the tremendous housing market that still lies ahead. The Forest Products Research Society is performing a real service in making the industry more conscious of the necessity of increased emphasis on research. If not prepared for this market, it is certain that some other industry will be ready and waiting to take it away.

Trends in the Utilization of Wood in the Home Building Industry Today and in the Future[1]

LEONARD G. HAEGER

Technical Director, Levitt & Sons, Levittown, Pa.

Traces the development of home construction to its present-day status as an industry. Competition and inroads being made by other products are cited, with suggestions made for improving the position of wood as a building material.

Introduction

BEFORE TRENDS in the utilization of wood in the home building industry today and in the future, can be decided upon the character of today's home building industry itself must be understood.

More than 300 years ago when our founding fathers landed on these shores one of their first jobs was to provide their families with shelter. They brought with them a technique of home building rooted deeply in the craft tradition—a masonry and wood tradition.

Houses reminiscent of Britain, France and Spain of that day were built—and here in the 1573 directives of Phillip II of Spain is found the first reference to wood as a requirement for home building and town site selection. This Spanish king's orders to the prospective founders of a town were to select "an elevated place where

[1] Presented at the Northeast Section Meeting, October 26, 1956, New York, N. Y.

are to be found health, strength, fertility and an abundance of land for farming and pasturage, fuel and *wood for building,* fresh water and a native people."

Thus before 1600 is found in crown law an understanding of the importance of wood for homes. As the children of our early settlers moved westward this wood tradition followed —first seen in our native log cabins with its almost wasteful use of wood; then in our Greek revival mansions with its sophisticated use of wood; and later in the Victorian houses in which the power jig saw had its first field day.

During the last 20 years, however, home building has undergone a transition, and has witnessed a trend not related to the craft tradition but tied into the overall industrialization of our country. Home building itself has become an industry, a fifteen billion dollar industry.

Position in Economy

To really understand today's home building industry its position in the overall economy must be noted. Admittedly it is difficult to tell just where home building stands because there is no unified standard of measurement to engage in a ranking of industries. However, the lack of such a standard will not prevent the making of meaningful comparisons. In 1955, the dollar value of home building put in place was 15.9 billion dollars, or 4.1 per cent of the gross national product of 390.9 billion dollars. Now this 15.9 billion dollars of work put in place (which omits land costs, developers profits, etc., and deals with new residential construction only) can be compared with these:

Factory Sales of passenger cars, trucks and busses	14.5 billion
Gross revenue of all 1st class railroads	10.1 billion
Export of goods from the U. S. (Excluding Military)	15.5 billion
Import of goods into the U. S. (Excluding Military)	11.4 billion
Factory sales of food manufacturing corporations	49.8 billion
Factory sales of paper and allied products	10.0 billion

Two factors have combined to transform home building almost overnight from a craft to an industry: First, the establishment of the Federal Housing Administration in 1934 and its decision in 1937 to make advance commitments; secondly, the acute postwar housing shortage.

After the war the overwhelming demand for houses was joined by the unprecedented opportunity to produce them, and home building for the first time in history began the large scale production of dwelling units *before* sale rather than *after* sale. This is an important step which all great industries have taken. Food, clothing, automobiles, steel and wood are produced before sale; thus home building finally has taken this tremendous step and lifted itself out of the craft tradition into a modern industry.

The builder is no longer a man in overalls. The men who have put home building on a scale of large production are, as in every great American industry, businessmen. They are the entrepreneurs, skilled primarily in administration and finance, production and merchandising. They are not just the trained craftsmen of the past—they are executives!

Today's operative builder will average something like twenty-five houses per year and will build houses in groups on adjoining plots. His large developments have become a part of today's America. These operative builders who start with a tract of land, obtain the professional assistance of skilled architects, secure favorable financing, select materials and products including wood with an eye towards sales appeal as well as cost, and schedule their production efficiently, account for 80 per cent of all professionally built houses in the United States.

These merchant builders of five or more houses per year comprise only 19 per cent of the builders in the industry, yet they put up 78 per cent of all professionally built houses. Compare these builders with our old carpenter friends who build one to four houses per year. They comprise numerically 81 per cent of the industry, yet account for only 22 per cent of the houses.

The following table presents the best available data on groups of builders by size: From this you can quickly see that 5 per cent of the builders account for over one-half of the houses. On one side are the old-time trained craftsmen, the carpenters who still pursue their skills, loving wood for its color, texture and ease of fabrication with familiar hand tools, but whose share of the market has been dwarfed by the transition of home building into an industry. On the other side are the men who have effected the transition, the merchant builders who are also concerned with wood because of its beauty and comparatively low cost, but who are really much more concerned with efficient production and are in no way tied to the hammer and hand saw.

Housing Changes

Back in 1948 the area of the average house was 740 sq. ft. By 1950 the area had risen to 900 sq. ft. It now appears that the area of the average house built in 1956 will reach 1240 sq. ft. In 1947 and 1948 two thirds of the houses had two bedrooms, and only one third had three or more bedrooms. Currently 80 per cent of the houses have three bedrooms or more with a very noticeable trend to four bedroom houses.

About 88 per cent of today's houses are one story, with 12 per cent being two story. About 55 per cent of the houses are being built without basements and of these, 16 per cent are on slabs and 39 per cent on crawl space. About 83 per cent of the houses are frame construction with 16 per cent masonry. While wood windows still predominate, steel and aluminum windows are increasing in usage. Of course every house has interior plumbing but only 48 per cent have one bathroom, 20 per cent have one and a half, 24 per cent have two bathrooms and 8 per cent have more than two bathrooms.

Houses, like many other products, are the result of design and production processes, and in this way are no different from the typewriter, the automobile, or a telephone. In spite of what has been said about the industrialization of home building, the product is the one important consumer product left that is put together by hand, in spite of the fact that many of the parts are mass-produced in factories. Plumbing fixtures, furnaces, lighting fixtures, thermostats and scores of other products are not produced on the job site. This does not mean that pre-fabrication should be urged as the coming solution, although this is a growing movement and the time may not be too far distant when a factory-built house will be more satisfactory and cost less than a house produced on the site.

There is nothing very new about the prefabrication of houses in this country. The first successful prefabricated wood house in Amercia was sent here from England in 1624. In the period 1848 to 1850 over 5000 prefabricated

Table 1.—HOME BUILDERS, BY SIZE

Homes built S per year		Percentage of All Builders	No. of Builders	No. of Units	Percentage of All Units
Small	1–4	81%	96,670	158,130	23%
	5–9	9	11,510	70,750	10
Medium	10–24	6	6,700	94,110	13
	25–49	2	1,970	64,940	10
Large	50– 99	1	1,270	73,030	11
	100–249	Less than 1	680	100,060	14
	250 plus	Less than 1	270	136,450	19
		100	119,100	697,470	100

wood structures were shipped from New York to California to help ease the housing shortage brought on by the Gold Rush. In the 1860's there was a thriving prefabrication firm in Boston named Skillings and Flint, and there is a copy of the catalog of this company printed in 1864 at the Library of Congress.

In 1957 and for many years to come wood will be the principal building material used in houses. If a house were only a technical thing, it would be easy—but a house has its technical, its social, economic and psychological sides.

Pressure of Competition

Today, the pressure of industrial processes are on those who are concerned with wood. The bulk of the roof covering business has been lost along with a tremendous amount of the exterior wall finishing business and at least a half of the finished floor covering business. The pressure of the metal window and door industry is heavy. The kitchen cabinet business, a last bulwark of wood is slowly losing to metals.

There still is the frame of the house, which might be 7.5 to 12 thousand feet of lumber, but even this take is being challenged by at least one steel manufacturer who is beginning to bring out light steel framing members for use with a variety of finishing materials.

What can be done about it? Tremendous strides have been made in the utilization of wood wastes. There has been progress in the development of wood building materials. But what is needed to maintain the position of wood in the home building industry is a research and product development program in tune with the times! Who has kitchen cabinets which are modular and functional, with adjustable shelves and all the things the homeowner needs?

Who has wood windows with stiles, rails and muntins to match the sight lines of steel? Who has a decent window wall—thru which to see the great out of doors— who has a real wood garage door with a man door? Who has structural framing members which are truly modular? Who has combined wood, metal and plastics into one component?

These and many other developments are needed to carry forward the great tradition of building in wood. The time is short—there is no point in trying to turn back the clock. There is no other way to get a good home.

The Prefabricated House—Opportunities for Greater Fabrication[1]

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Greater degree of prefabrication—and economy—without exceeding shipping limitations will result from increased prefinishing. New finish materials in new sizes hold the key to the production of economical, prefinished assemblies.

Introduction

THE TERM "PREFABRICATED HOUSE" no longer has the distinct meaning that once separated it from the term "conventional house". Since the end of World War II both the prefabricator and the conventional builder have made rapid progress in the technique of mass buying, in the use of subassembled components such as window and door frames, and in the use of prefinished materials; for example, flooring. Today then, the distinction between the prefabricated and the conventionally built house is more one of degree of prefabrication rather than a difference in basic methods.

At one end of the prefabricated scale is the so called "precut" house. Here the individual pieces of framing are precut to length, machined, and coded for assembly into the house at the site. Sheet materials (sheathing, etc.) trim, finish and other materials are packaged and shipped in the proper quantities for the proposed house. This end of the scale is limited by the advantages that can be offered to the builder who must purchase the package and erect the house. Fabrication at the factory must exceed the degree that can be economically duplicated on the site.

At the other end of the prefabricated scale is the panelized house in which framing, sheathing, vapor barrier, insulation and finish materials are assembled into wall, roof and ceiling panels. Trim and other miscellaneous items are packaged and shipped as for the precut house. This, generally, is the greatest degree of fabrication that has been successfully reached by the prefabricator.

One measure of the level of fabrication that may be taken is the precentage of total dollar volume accounted for by the prefabricator's "package price". For the panelized house this figure will be approximately 1/3 of the total cost of the home including land. In other words, approximately 2/3 of the total price is spent locally for the land, foundation, services and labor involved in the erection and completion of the house.

If the cost of the land is deducted and the comparison made on the basis of the house alone, the package price will account for approximately 45 per cent of the total house. This is a positive indication that there is still progress to be made in the direction of greater fabrication and a trend in this direction is expected.

Limiting Factors

What are some of the limitations that have fixed the prefabricated house at its present level of development?

Primary among the limiting factors is transportation. The majority of the industry relies upon truck transportation for the delivery of its product from factory to building site and a 500 mile radius is generally considered to be the economic limit. National Homes with its present truck fleet is capable of shipping an 8,000 cubic foot house, exclusive of foundation of course, in a van 35 x 7½ x 8 feet, a cubic content of 2,100 cubic feet. This is only possible with careful attention to the details of construction and with constant compromises between the degree of fabrication that is desirable and the volume of the assembly.

An equally important factor is weight during which transit is controlled by state and local laws. While the total weight of the package is approximately constant regardless of the degree of fabrication, the distribution of this weight on the van is in-

[1] Presented at the Northeast Section Meeting, Oct. 25–26, in New York, N. Y.

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fluenced by whether the material is shipped loose or as part of an assembly.

As a means of controlling this critical problem it is common to find the prefabricator using framing sizes smaller than those conventionally used in the site-built home. A typical example of this is the National Homes exterior wall panels which are framed by 2- x 3-inch studs rather than the conventional 2- x 4-inch.

This reduction in framing size is compensated for by the use of the sheathing and finish materials as structural elements in the panel.

It should be pointed out here that earlier remarks concerning the present degree of fabrication were not intended to indicate that systems of virtually complete fabrication have not been developed in the past. Such systems have been developed and proven to be technically feasible. But when faced with the transportation factor, these have become economically impractical or have been so altered in appearance or size as to be difficult to market.

It is apparent that any immediate increase in the amount of fabrication beyond that described for the panelized house must be accomplished without adding significantly to the weight and bulk of the house package. The most logical place for this to be accomplished is in the area of finish coatings and films.

Finishers

As previously mentioned, prefinished flooring is a product that is already well established in the home building field. Other products such as prefinished wood shakes and asbestos cement shingles are equally accepted. They have proved their economic advantage to both conventional builder and prefabricator. In addition some fabricators, such as National Homes, have been priming trim, siding, doors, shelf material and other miscellaneous items successfully to eliminate a part of the considerable labor involved in the site finishing of the home

Certainly, then, there is still the possibility of improvement through the application of these final finishes at the factory. An even more attractive opportunity exists for the development of finish materials and finishing systems (films or coatings) for shop application to the large interior areas of walls and ceilings that are, for the most part, finished conventionally at the building site.

While describing these possibilities as attractive opportunities it must be equally obvious that they are not new. For every advantage that can be claimed, a multitude of problems can be pointed out that have prevented adequate solutions in the past. These problems range throughout the entire spectrum from technical and structural through the aesthetics of customer acceptance and color preference.

What is new, however, is the rapid strides that have been made recently in the field of synthetic films, coatings and boards. Under these circumstances it is desirable to examine briefly the problems once again and to define the goal the prefabricator hopes to achieve. They will influence drastically the part that wood and wood base products will play in the future of mass produced housing.

By their very nature, interior finish materials must present a more perfect appearance than any other portion of the house and the greater the flat unbroken area of the material, the more objectionable becomes the presence of a blemish or flaw. By this criteria then, the ceiling area is most critical, wall area is next and trim the least critical of the three. The presence of a random texture on the surface is one of the most promising means of concealing minor shipping damage or defects.

Joints Most Critical Problem

By far the most critical item from the standpoint of appearance is the problem of joints in the finish material. The prefabricator is generally committed to the use of sheet materials that are basically 4 x 8 foot in size with resulting joints at 4-foot intervals. While there are certain techniques of concealing or emphasizing joints in prefinished board to make them more acceptable, none of the solutions noted have the same degree of acceptability as the more conventional materials. For wall systems, the ultimate solution is almost certainly an 8-foot wide board capable of being produced and handled in sufficient lengths to allow the concealment of necessary joints behind intersecting partitions.

Another important problem is the structural connection of the finish material to the framing. Since at present there is no particular combination of board and adhesive which is simultaneously adaptable to the production schedule and which will permit a glued-only joint, the glue-nail technique is the present method of connection.

For a board prefinished at the source of manufacture, this requires the setting and filling of nail holes during application to the frame with the associated problems of shrinkage and color matching in the filling compound. Wood base products however do enjoy a particular advantage over some of the competitive materials in the connection problem since it is possible to use a nail with a less objectionable head and one which may be set below the surface without loss of its structural value. It appears the ultimate solution here will be the elimination of the nails through the development of the proper combination of board, adhesive and production techniques. In the meantime the field of coatings and films may hold promise of some improvement.

Dimensional Stability

A wood or wood base board developed for the specific purpose of providing a prefinished wall surface, would have to meet the general structural requirements applicable to such use. This would require durability, bending strength and stiffness, impact and scuff resistance and internal shear strength comparable to those materials conventionally used. Of paramount importance, assuming the 8-foot width as necessary, is the problem of dimensional stability. Since gluing would be an integral part of the application technique, the development of shear between board and framing would greatly increase the importance of this factor. Buckling or warping with moisture content changes would be more than an appearance problem in the field of the board and would instead exhibit itself in bowing and movement of the entire wall assembly

Despite the obstacles to be overcome, it seems certain that further improvement can and will be made along these lines. National Homes is sufficiently confident of the economic importance of prefinishing that in 1957 certain houses in the line will be prefinished to a greater degree than ever before attempted. In the main this will consist of finish painting as well as priming being accomplished in the shop, but it also will include the use of some prefinished wall and ceiling materials. Considerable experience will be gained in the handling of the presently available materials; it is hoped that interest will be aroused in new materials for the same purpose

Summary

The field of prefinishing holds one of the best opportunities to increase the degree of fabrication, and thereby the economy, of the mass produced house without exceeding the present shipping limitations. The ultimate solution to many of the attendant problems lies in the development of new finish materials in new sizes, in the further development of coatings and films applicable to production line methods and speeds, and in the fabrication techniques necessary to produce economical, prefinished wall and ceiling assemblies.

Expanding the Use of Wood Residues for Pulp Production[1]

R. M. SAMUELS

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Pulp production is expected to increase 65 per cent by 1975 and much of the increase must come from new plants based on new wood supplies. Oregon sawmills and veneer plants produced in 1953 about 2 million tons of unused chippable wood residues and 1.1 million tons used for fuel, much of which could be diverted to pulp use. Research is needed to achieve further utilization of wood residues, to increase pulp yields, and to increase pulp utility.

PULP PRODUCTION in the United States may expand 65 per cent in the next 20 years. Population increase alone would result in use of one-third more pulp by 1975. Per-capita consumption of paper has been expanding rapidly, however, increasing from 180 pounds in 1925 to 410 pounds in 1955 and the predicted 65 per cent increase in pulp production assumes a per-capita consumption of 500 pounds by 1975. These estimates were made by the Writing Paper Manufacturers Association and the United States Pulp Producers Association (3, 4).[2] A per-capita consumption of 500 pounds of paper in the United States by 1975 is conservative because of expected demand for new kinds of paper. Raw material for pulp production will be needed in increasingly greater volume.

Some increased pulp production can come from expansion of present facilities, but much of the increase must come from new plants based on new wood supplies. In Oregon, large volumes of mill residues are developed in sawmill and veneer operations. Most of the recent and proposed expansion of pulp and paper facilities for the state is based on use of mill residues as raw materials. Usage of Oregon mill residues for chips during the past several years is shown in Fig. 1 (1, 2). In 1944, only 1,360 tons of mill residues were chipped for pulping. The volume chipped rose to 480,000 tons in 1953, and to 863,000 tons, dry weight, in 1955.

The predicted volume of 1,000,000 dry tons of chips for 1956 is based on straight-line extrapolation of the data for 1953 and 1955. These data include chips used in hardboard and softboard, although the quantity used for such board products is a small portion of the total.

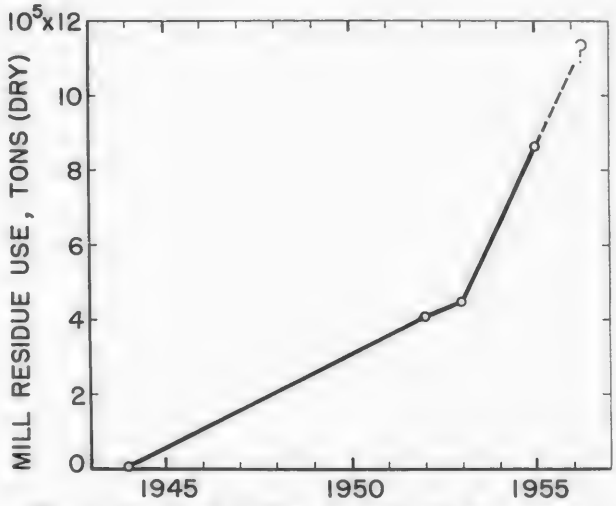

Fig. 1.—Use of mill residues for pulp and board products in Western Oregon.

Current Supply

What is the current supply of chippable residues? Can this supply be exhausted? To what extent? The answers to these questions are important to the pulp industry in Oregon. Volumes of mill residues developed in 1953 in Oregon and in Lane County are listed in Table 1, where "chippable" material represents residues of a size suitable for chipping (1). Much of this material is not now chipped because of lack of barking and chipping equipment. Unused but chippable residues in Oregon would support additional kraft pulp production in excess of 2,000 tons per day. In Lane County, the unused chippable residues would produce nearly 500 tons of kraft pulp per day.

Complete utilization of chippable residues presents problems. Small mills cannot afford barkers and chippers to process small volumes of residues. Processing at a central chipping plant involves transportation costs. In a firm and rising market, however, chip pro-

Table 1.—DISPOSITION OF WOOD MILL RESIDUES IN OREGON AND LANE COUNTY IN 1955 (1)

Residue	Oregon					Lane County				
	Used					Used				
	Fuel	Small wood items	Pulp and fibre	Total	Unused	Fuel	Small wood items	Pulp and fibre	Total	Unused
	Thousands of tons (dry weight)									
Sawmills										
Chippable	1,054	194	389	1,637	1,902	103	37	125	265	368
Shavings	843	-	-	843	758	185			185	110
Sawdust	1,476			1,476	883	221			221	183
Veneer plants										
Veneer trim	60		91	151	83	2		42	44	4
Cores	9	63	-	72	14	-	17	-	17	1
Subtotals	3,442	257	480	4,179	3,640	511	54	167	732	666
Percentage of total available	44	3	6	53	47	36	4	12	52	48

[1] Presented at meeting of FPRS Pacific Northwest Section, May 7-8, 1956, in Eugene, Ore.

[2] Numbers in parentheses refer to literature cited.

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duction is competitive with sale or use of residues for fuel at large mills.

In mills where barkers and chippers have been installed it has been found that chip recovery was greater than anticipated. Recovery of less than half a unit of chips per thousand board feet of lumber produced is to be expected (2). Mills with barkers and chippers, however, recover up to 0.7 unit of chips per thousand board feet of lumber, because sale of chips permits a changed standard of utilization in the woods (1). Logs yielding small volumes of lumber and veneer can be processed economically where a plant can convert the balance of such logs to chips.

Since there is an expanding demand for paper, and since residues are available as raw material, interest is strong in building new pulp mills. According to a bulletin of the Oregon Development Commission, five different organizations are considering plans for pulp mills in Oregon (8). One firm has announced its intent to build a mill in the Toledo area. All mills under consideration are kraft mills and would use residue materials from sawmill and veneer operations.

Problems Limiting Expansion

Since development of a large paper industry in this area is progressing rapidly, the situation is encouraging. There are, however, some serious problems involved. Some problems, such as water supply, waste disposal, and atmospheric pollution, are not peculiar to the area alone, but to the entire paper industry. Two specific problems that could limit expansion in this area are: obtaining assurance of long-term wood supply; and limitations in usability of pulp produced from Douglas-fir mill residues, since the bulk of available residues is Douglas-fir. Problems of raw-material supply may be solved initially by mergers of paper and timber firms, through long-term agreements with lumber or plywood manufacturers, or by formation of new firms holding large stands of timber within their community of interest.

Long-term, continuous expansion of the paper industry in the state is dependent also on research to:

- Increase raw material available through closer utilization of all wood residues.
- Increase yield of pulp per unit of wood.
- Increase utility of pulps produced.

Vast amounts of wood developed in logging operations cannot be recovered economically under current conditions. Much of this small, broken, or partly defective material might be handled economically if a satisfactory means is achieved to produce bark-free chips in the woods. Likelihood of using logging residues will be increased by developing:

- Methods of removing bark in the woods.
- Means of separating bark from chips.
- Processes and products that will tolerate appreciable amounts of bark (5).

Fig. 2.—Wood chips from Santiam Lumber Co., Sweethome, Ore., being shipped to a kraft pulp mill.

Close utilization of wood residues should include use of hardwoods, sawdust and planer shavings. About 16 per cent of the nation-wide pulp production is from hardwoods (6). In the East, aspen is the favored hardwood pulp species, but use of such woods as birch, maples, gums and oaks has been increasing. In Oregon, the proportion of hardwoods used for pulp is low and is confined to two species, black cottonwood and, recently, red alder. Large stands of several other species now are unexploited but only limited knowledge of their pulping characteristics is now available. Since pulping of residues developed in logging and milling hardwood species would be important to their economic use, investigation of their pulping potentialities would be desirable.

Both planer shavings and sawdust have possibilities as raw materials for pulping. Sawdust, in limited quantities, is used commercially to produce pulps with short fibers for use as a filler in mixtures with long-fibered pulps. Cooking of sawdust requires a rotating digester or continuous system involving agitation for required circulation of cooking liquor through the closely packed mass of particles.

Shavings produce pulp longer-fibered and stronger than pulp from sawdust, but present a handling and transportation problem because of their low bulk density. The Oregon Forest Products Laboratory made a limited study of the pulping of planer shavings in the form of briquets. Tensile strength of the pulp from Douglas-fir shavings was nearly equal to that of kraft from chips, but bursting strength was 85 per cent and tear resistance 55 per cent that of pulp from chips (10).

Pulping Methods

Interest in increasing pulp yields has grown as the volume of cheap and accessible wood has dwindled and cost of stumpage has risen. There are several methods of producing chemical pulp in higher yields than by conventional processes. Conventional kraft and sulfite processes give yields ranging from 40 to 50 per cent. These processes can be modified by using shorter cooking times or lower temperatures to increase yields. To obtain yields much above 50 per cent, however, cooked chips must be fiberized mechanically because they do not break up easily. Fiberizing is done, usually, in disk mills that require 5–10 horsepower-days, or 150–170 kwh, per ton of pulp fiberized.

High-yield pulps generally are somewhat darker than their conventional counterparts, and strength of these pulps declines with increasing yield. Bleaching high-yield pulps involves high chemical costs and results in some loss in yield.

The neutral sulfite semichemical process developed by the U. S. Forest Products Laboratory uses a somewhat expensive but quite selective chemical,

Fig. 3.—**Wood chips in this huge pile are from sawmill residues. The Western Kraft Corp. plant at Albany, Ore., presents an outstanding example of integration between the pulp and sawmill industries, an immediate potential for all of western Oregon.**

sodium sulfite, usually with some sodium carbonate added to maintain alkalinity. The result is increased preferential removal of lignin and increased content of hemicellulose in the pulp. The augmented selectivity in removal of lignin makes this process well adapted to pulping of hardwoods because of their lower lignin content, and usually produces pulps of higher strength at a given yield than do other high-yield processes. High hemicellulose content acts to produce sheets having great stiffness, which is important in corrugating medium, a major product of high-yield pulp (7). Low lignin content makes bleaching more economical than that of other high-yield pulps, resulting in increasing use of bleached neutral sulfite-semi-chemical pulp in high-quality printing papers.

It would be desirable to get 100 per cent yield from the wood and this goal is approached closely in the manufacture of groundwood pulp. Groundwood pulp, the major constituent of newsprint, adds bulk, absorbency, and opacity, but little strength to printing, toweling, and tissue papers. The traditional process involving the grinding of 2- or 4-foot round or squared cants against rotating cylindrical grindstones has the disadvantage of requiring substantial expense for wood and milling. At least two equipment manufacturers have developed processes that make a groundwood-type pulp from chipped residue materials. Chips are fiberized in screw presses and then wet-ground in disk mills. These processes probably will be in commercial use soon.

Utilizing Douglas-fir

Process developments alone will not, however, ensure complete residue utilization in the Northwest. Most residue material is Douglas-fir. Because of its tendency to darken, its resistance to bleaching, and its fiber characteristics, Douglas-fir has found limited use in paper grades of groundwood pulp.

This situation raises the problem of extending the usefulness of Douglas-fir pulps. Limitations of Douglas-fir as a pulp species stem both from nature of the fibers and tendency to darken with exposure to heat, light, and chemical processing. Douglas-fir has fibers of similar length but greater thickness than fibers of spruce, white fir, or west coast hemlock (9).

Kraft pulps made from Douglas-fir have higher tear resistance but somewhat lower bursting and tensile strengths than similar pulps made from west coast hemlock. Douglas-fir kraft pulps are used in both bleached and unbleached grades of wrapping paper and container boards. This is a fairly broad field of use, but use of Douglas-fir has not extended greatly into newsprint, magazine and book papers, or into tissues.

In order to use effectively the volumes of Douglas-fir residues available, it is desirable to use them to manufacture papers that already are being produced in considerable quantity in this area. Douglas-fir pulp prepared by present processes is not well-suited to use in sheets where softness, printability, and dimensional stability are important. High quality tissue and printing papers customarily are made largely from sulfite pulps. Douglas-fir is resistant to pulping by the usual calcium-base sulfite process. It can be pulped by the ammonia-base sulfite process, but pulp produced is of low tensile strength and dark color. It is desirable to devise methods of pulping Douglas-fir or treating its pulp to enlarge the number of types of paper in which it can be used.

The Oregon Forest Products Laboratory currently is working on two projects to extend use of Douglas-fir pulps. One project is concerned with manufacture of corrugating medium and the other with manufacture of newsprint. For corrugating medium, a high-yield process is required with chemical cost and pulp properties competitive with pulps from high-yield processes using straw, bagasse, pulp-species softwoods, and hardwoods as raw material. Douglas-fir pulp for newsprint would require some modification of the usual fiber characteristics and an economical method for improving brightness.

Pulp and paper are in great demand and that demand is growing. Oregon has a large readily available source of pulping raw material in its mill residues and an enormous potentially available source in its hardwoods and logging leftovers. But development of the largest potentialities of the industry in Oregon depends on how well we solve the problems of:

- Greater utilization in the woods, at the sawmills, and at the pulp mills.
- Development of pulps and papers with the broadest range of uses and markets.

Acknowledgment

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Effect of Storage on Phenolic Resins and Their Ability to Stabilize Wood Dimensions[1]

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The effect of temperature and length of storage on the apparent increase in degree of polymerization of phenolic resin, and the effect of increased polymerization upon the ability of the resin to impart dimensional stability to wood were studied. The suitability of the resin for making impreg was affected, but its effectiveness for stabilizing wood was only slightly reduced.

Introduction

WITH INCREASING USE of resin-impregnated wood[3,4,5] has come increased need for more information on the effect of prolonged storage of a phenolic resin on its usefulness for making impreg. In the manufacture of impreg, the commercial resin (70 per cent solids) is diluted to a solids content of 30 per cent (based on the total weight). Such a solution readily impregnates wood. These solutions (70 or 30 per cent solids) are not stable, but undergo aging. The term polymerization or degree of polymerization will be frequently used in this report. They should not be interpreted literally; they are simply used to indicate that some reaction occurs during aging.

As a result of this aging, concentrated resin eventually can no longer be diluted to 30 per cent solids without separation into two phases. The storage life of the concentrated solution is the length of time that the solution can be kept under given conditions and still be dilutable with water to form a solution having a 30 per cent solids content. The storage life of a 30 per cent solution is the length of time it may be stored before it separates into two phases. Since the aging process involves a chemical reaction, storage temperature is obviously the most important factor determining the storage life.

One purpose of this work was to determine the interrelation between resin concentration, temperature, and storage life. Another purpose was to relate the aging effect with the ability of the resin to make impreg.

Methods of Test

Determination of Effect of Temperature of Storage on the Storage Life of Resins: A phenolic resin was stored as received from the manufacturer at temperatures of 65°, 70°, 75°, 80°, and 90° F., and the solubility of water in the resins at 75° F. was determined periodically. Water was added to a weighed amount of resin until the solution became cloudy. At this point of dilution, the resin-water mix will separate into two fractions within a day. This dilution is considered to be the maximum dilutability of the resin with water, and the per cent of water (based on total weight) in the resin-water mix is then calculated.

The fresh resin was also diluted with water to solids contents of 15, 22.5, and 30 per cent, and was then stored at 65°, 70°, 75°, and 80° F. (±1° F.) The time at which the solutions separated into two fractions was noted. Experience at the Forest Products Laboratory has shown that phenolic resin solutions with the same specific gravity will have approximately the same solids content. Resin solutions with a specific gravity of 1.080 at 25° C. (77° F.) will contain approximately 30 per cent of resin. To obtain this concentration, the ratio of resin to water by weight was 425 to 575 for this particular resin. Solutions containing 22.5 per cent of resin were obtained by mixing three parts by weight of this diluted solution with one part of water. Solutions containing 15 per cent of resin were obtained by mixing equal parts by weight of water and the resin solution with a 1.080 specific gravity. The specific gravity of the 22.5 per cent resin solutions at 25° C. was 1.058, and that of the 15 per cent solutions was 1.038.

After the initial treatment of wood in commercial practice, the treating solutions contain extractives leached out of the mahogany veneer. Resin solutions containing extractives from mahogany wood were therefore prepared to determine relative storage life more realistically. Solutions containing extractives were prepared by soaking three parts by weight of veneer in ten parts by weight of 30 per cent resin solution for 16 hours at room temperature. The 22.5 per cent and 15 per cent solutions were then prepared by diluting the 30 per cent resin solution containing extractives. These solutions were then stored at 65°, 70°, and 80° F., and the periods of time required for the separation of the resin solutions were noted.

Determination of the Effect of Increased Polymerization of the Resins on Their Ability to Stabilize Wood: Honduras mahogany and yellow birch cross sections were impregnated with resin solutions of 15, 22.5, and 30 per cent concentrations. The solutions were made up from resins of four apparent degrees of polymerization designated as A, B, C, and D.

Designation	Aging history	Solubility of water (per cent water in total mix)
A	None	Miscible in all proportions
B-1	70° F., 87 days	7[illegible]
B-2	90° F., 17 days	7[illegible]
C	75° F., 97 days	5[illegible]
D	80° F., 97 days	[illegible]

Note that the "B" resins were obtained by storing the fresh resin at 70° F. for 87 days or at 90° F. for 17 days. The solubility of water in the resins was the same for both conditions, which suggests that both resins underwent the same change.

In commercial practice, only resins of A and B aging histories can be used for making impreg. The resins that were aged more severely (C and D) were included, however, to learn the effect of such aging on their ability to stabilize wood.

Only resins with no aging are miscible in water at the three different

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[1] Supported in part by funds from the Ford Motor Co., Dearborn, Mich.

[2] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[3] Stamm, A. J. 1946. Modified wood. Amer. Wood Preservers' Assoc. Proc.

[4] Stamm, A. J. and Seborg, R. M. 1955 Revised. Resin-treated wood (impreg.) Forest Products Laboratory Report No. 1380.

[5] Seborg, R. M. and Vallier, A. E. 1954. Application of Impreg for Pattern and Die Models. Forest Products Journal 4: No. 5, 305–312.

The Authors: Ray M. Seborg, a research chemist at the Forest Products Laboratory, received a B. S. degree from Montana State College. He has written several reports on means of modifying the properties of wood, and is a co-holder of several patents on improved woods.

Harold Tarkow holds a Ph.D. from the University of Wisconsin. Formerly associated with the Portland Cement Association and Bradley Polytechnical Institute, he has been at the Forest Products Laboratory since 1943 where he has been doing work on the dimensional stabilization of wood and on adhesion.

concentrations used in these experiments. For example, the solubility of water in resin B-1 is 75 per cent. With resin B-1, therefore, it is possible to make a solution containing 70 per cent water (30 per cent solids) but not 78.5 per cent water (21.5 per cent solids). To prepare solutions with a lower solids content, a water-alcohol solvent containing two parts of water and one part of 95 per cent ethyl alcohol was used. With the five resin preparations described in the previous tabulation, solutions were made up containing 30, 22.5, and 15 per cent solids in an alcohol-water solvent. In addition to these solutions, resin A was mixed with water to these levels of solid content. The solutions in water are designated A-1, while the designation A-2 is used for those solutions containing A resin in alcohol-water.

Seven replications of wood were used with each resin formulation. The specimens for each group were selected according to statistical pattern so that the specimens for the two species were matched for each condition of treatment.

Discussion of Results

Effect of Temperature on Storage Life of Resin: The solubility of water at 75° F. in the various aged resins is given in Table 1 and Fig. 1. The solubility of water decreases with aging time in a linear manner, at least down to solubilities of the order of 75 per cent. Below solubilities of about 75 per cent, the curve deviates somewhat from the linear relationship. For the production of impreg, the phenolic resin should be such that it can dissolve 70 per cent or more of water (based on total weight). As a first approximation, it will be assumed that the relationship between storage time and water solubility is linear down to concentrations of 70 per cent (30 per cent solids).

In Fig. 1, the slope of the water solubility-time curve decreases with decreasing storage temperature, which indicates that the rate of change of structure or size of the resin molecule decreases. In Fig. 4, the logarithms of the slopes of the curves in Fig. 1 are plotted against the reciprocal of the absolute temperature. The linear relationship shows that the Arrhenius equation is applicable:

$$\log \frac{K_1}{K_2} = \frac{E(T_1 - T_2)}{2.303 \times RT_1T_2} \qquad (1)$$

where K_1 and K_2 are the slopes of the curves (Fig. 1) at absolute temperatures T_1 and T_2, R is the gas constant, and E is a constant usually identified as an activation energy. The exact meaning of E here is obscure, so it will

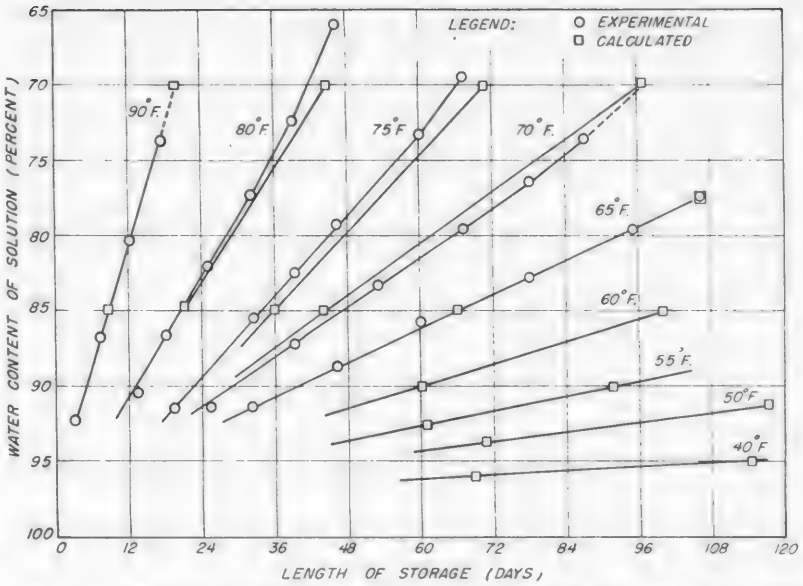

Fig. 1.—Relationship between length of storage and maximum dilutability of a phenolic resin stored at various temperatures. Maximum dilutability was measured by the water content of the resin-water solution at the point of separations at 75° F.

be treated simply as a constant without attaching any physical significance to it. The equation for the curve is

$$\log K = 18.04 \frac{(T\text{-}303.1)}{T} \qquad (2)$$

With the aid of equation 2, the value of K can be calculated at the absolute temperature T. In Fig. 1, such calculated values are represented by small squares. Where comparison can be made with experimental values, the agreement is good, which shows that equation 2 is applicable, at least in the region covered by the experiment. Equation 2 was also used to calculate K for temperatures other than those studied experimentally. These calculated values are given in Fig. 1.

The experimental and calculated values of storage life of a phenolic resin at different temperatures are given in the second and third columns of Table 2. The storage life of the resin can be more than doubled by decreasing the storage temperature from 80° F. to 70° F., and more than tripled by reducing the storage temperature from 80° to 65° F.

The comparative storage life of the resin tested when stored prior to dilution with water and when diluted with water before storage is shown in Fig. 2.

Table 1.—RELATIONSHIP BETWEEN LENGTH OF STORAGE AND MAXIMUM DILUTABILITY WITH WATER OF A PHENOLIC RESIN WHEN STORED AT FIVE DIFFERENT TEMPERATURES

Length of storage Days	Water content at point of separation of resin-water solution at 75° F. after storage at five temperatures*				
	90° F. Per cent	80° F. Per cent	75° F. Per cent	70° F. Per cent	65° F. Per cent
3	92.2				
4	90.4				
7	86.7				
12	80.2				
13		90.3			
17	73.6				
18		86.6			
19			91.6		
25		81.9	88.6	91.3	
32		77.3	85.4	89.3	91.3
39		72.3	82.5	87.1	90.6
46		65.9	79.2	85.0	88.7
50		62.0			
53			76.5	83.3	87.2
60			73.2	81.3	85.9
67			69.5	79.5	84.7
74			64.5		
77			62.2		
78				76.4	82.8
82			58.2		
87			54.2	73.6	
95					79.6
97			48.2		
106					77.4

*Water content expressed as percentage of water in total resin-water solution.

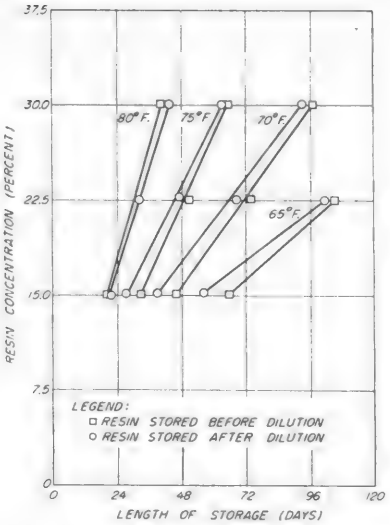

Fig. 2.—Comparative storage life at four temperatures of a phenolic resin stored before and after dilution with water.

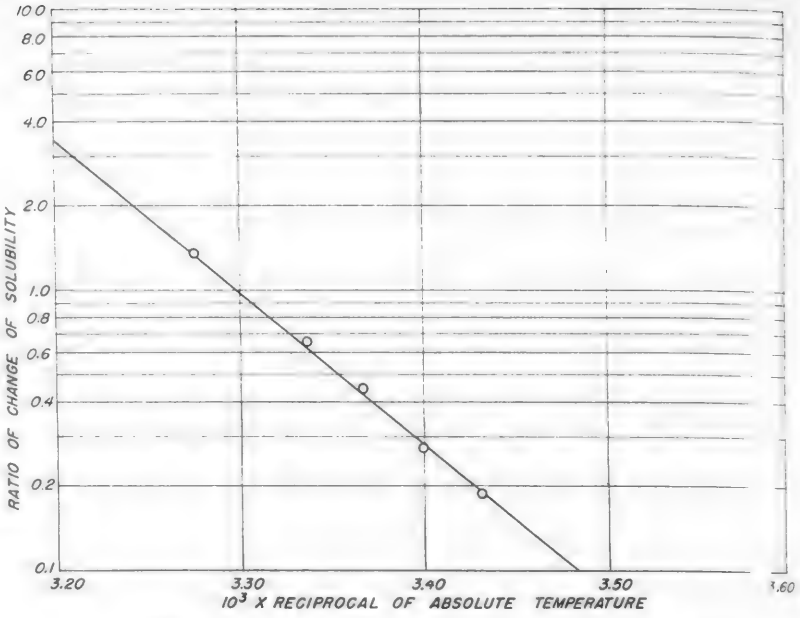

Fig. 4.—Logarithm of rate of change of solubility versus reciprocal of absolute temperature of storage of a phenolic resin.

For resins stored prior to dilution with water, the maximum time that the resins can be stored at various temperatures and still be miscible when subsequently diluted with water to 15, 22.5, and 30 per cent resin concentrations was obtained from Fig. 1. In this figure, resin-water mixes containing 85, 77.5, and 70 per cent of water represent resin concentrations of 15, 22.5, and 30 per cent, respectively. For resins diluted with water to 15, 22.5 and 30 per cent resin concentrations before storage, the storage life was determined by observing the time of separation of the resin-water mix at the storage temperature.

The miscibility of resins stored before dilution was determined at 75° F., but the storage life of the resin-water mixes was determined by observing the time of separation of the mixes at the temperature of storage. The storage life at 65° and 70° F. is, therefore, greater for resins stored prior to dilution with water than for the aqueous resin solutions, because the resin is more miscible in water at 75° F. than at 65° and 70° F. Conversely, the storage life at 80° F. is less for resins stored before dilution than for the resin-water mixes, because the resin is less miscible at 75° F. than at 80° F. The results show that, in general, the storage life of resins diluted with water before storage and the storage life of resins for subsequent similar dilutions are quite comparable when the resins and solutions are stored and tested under similar conditions. Whether the resins were stored after being mixed with water or without the addition of water did not significantly affect the subsequent miscibility of the resins. The practice of diluting resins with water before storage, therefore, has no advantage in increasing the storage life of the resin.

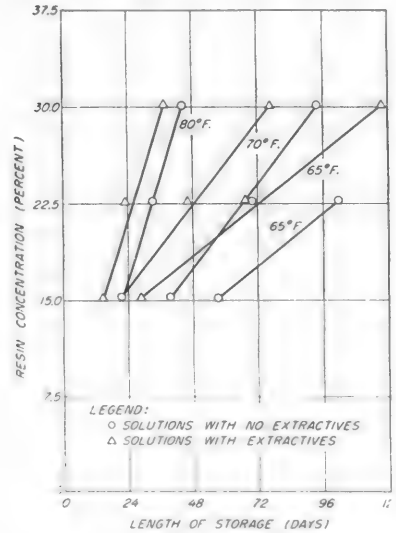

Fig. 3.—Comparative storage life at various temperatures of three concentrations of aqueous phenolic-resin solutions containing mahogany extractives and three concentrations containing no extractives.

The effect of mahogany extractives in the resin solutions on the storage life of the solution is given in Fig. 3. The results show that the presence of extractives in the resin solution reduces the storage life of the treating solutions. However, the difference in length of storage between solutions of different resin concentrations, as shown by the slope of the lines, is the same for resin solutions with or without extractives when stored at comparable temperatures. The difference between the length of storage of plain resin solutions and those containing extractives is the difference in the zero intercept of these lines. In other words, the presence of extractives in the treating solution decreases the immediate miscibility of the resin in water, but it has no apparent effect on the subsequent rate of polymerization of the resin in the treating solution.

The slope of the lines (Figs. 2 and 3) is the same for (1) resins not diluted with water, (2) aqueous resin solutions, and (3) aqueous resin solutions containing mahogany extractives when they are stored at comparable temperatures. Therefore, the storage life of resin solutions at various storage temperatures can be calculated by the formula used for calculating the storage life of the resins themselves. The calculated maximum storage life of resin solutions containing extractives for various storage temperatures between 40° and 90° F. and experimental values for three storage temperatures are given in Table 2. Similar values for undiluted resin are also given.

In estimating the storage life of resin solutions at various storage temperatures, the values selected should be somewhat smaller than the maximum calculated values to avoid any possible separation in the resin-water mix. Since this work did not include the effect of varying amounts of extractives in the treating solutions on the storage life of the solutions, the values given in Table 2 are only approximate. The results of this study, however, should serve as a guide in determining practical storage temperatures of resins and resin solu-

tions and the expected life of the solutions under different conditions of storage.

Effect of Increased Resin Polymerization on Ability to Stabilize Wood Dimensions: Values for the reduction in swelling of wood for all conditions of treatment for the two species of wood are given in Table 3. The resin content of the wood for each condition of treatment is given in Table 4. All the specimens treated with each of the six different solutions had approximately the same average resin content. The reduction in swelling, however, decreased slightly with each stage of increased polymerization of the resins. Resins stored for almost the maximum time that they can be stored and still be suitable for use were about 94 per cent as effective in imparting dimensional stability to wood as were the resins that were miscible in water in all proportions. The prime factor, therefore, in determining the suitability of resins for use after various storage periods is the ability of the resin to remain in solutions containing 30 per cent of solids or less.

The stabilization values obtained by impregnation of the wood with either aqueous or alcohol-water solutions were approximately the same for the same resin content (Table 3). In subsequent figures, therefore, the values for resins miscible in water in all proportions are averages for aqueous and alcohol-water solutions.

The values for the effectiveness of resins brought to the same degree of polymerization under different aging conditions (70° F. for 87 days or 90° F. for 17 days) were approximately the same (Table 3). Therefore, the values shown for resins (stage B) in subsequent figures are averages for the two conditions of storage.

Wood that is treated with phenolic resin and subsequently oven-dried increases in size. Fig. 5 shows the relationship between resin content (stages A, B, C, and D) and the percentage increase in volume of the wood. In general, at a given resin content, the value for the percentage increase in volume decreases with increasing apparent molecular size.

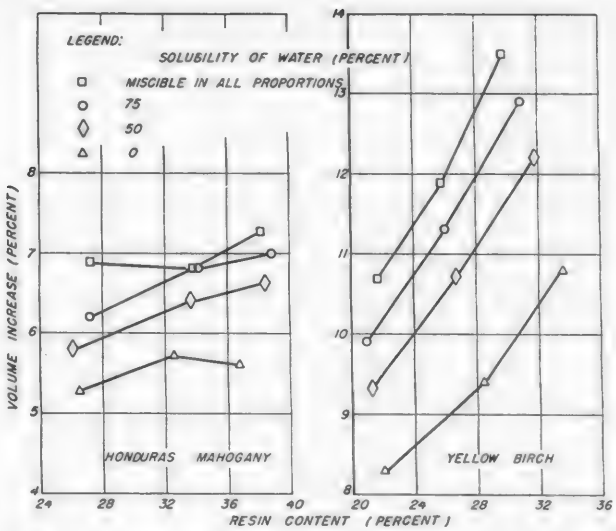

Fig. 5.—Relationship of the volume increase resulting from resin impregnation to the resin content of wood impregnated with a phenolic resin at four different stages of polymerization (as characterized by the solubility of water). The solubility of water is based on the total weight of the resin-water solution, and the volume increase and resin content are based on the volume and weight of the oven-dry untreated wood.

The increase in oven-dry dimensions following treatment with resin is due to the deposition of resins within the cell walls. If the specific gravity of the cured resin is known, it is possible to calculate the weight of the resin deposited within the cell walls, assuming the resin adds its volume to the external dimensions of the wood. The percentage of the total resin in the wood that is present in the wood substance is then given by

$$\frac{(V_1 - V_2)d}{W_1 - W_2} \times 100$$

where V_1 is the volume of oven-dry treated wood, V_2 is the volume of oven-dry untreated wood, d is the density of the cured resin (assumed to be 1.28 grams per cubic centimeter), W_1 is the weight of oven-dry treated wood, and W_2 is the weight of oven-dry untreated wood.

It is of interest to compare the percent of resin present in the cell wall at different total resin contents. In Fig. 6, the ratio of the resin in the cell walls to that in the wood is plotted against the resin content of the wood. The curves show the following:

(1) As resin content increases, the fraction of the total resin that is deposited within the cell walls decreases, and more and more of the resin is deposited within the cell cavities.

(2) With increasing polymerization, the fraction of the total resin that is present in the cell walls decreases. Obviously, with increasing molecular size, a smaller fraction is able to penetrate the cell walls. It is apparent that the decrease in dimensional stability of wood treated to the same

Table 2.—STORAGE LIFE AT VARIOUS TEMPERATURES OF A PHENOLIC RESIN AND OF A 30 PER CENT RESIN SOLUTION CONTAINING EXTRACTIVES FROM MAHOGANY WOOD

Storage temperature °F.	Maximum storage life			
	Resin		Resin solution containing extractives	
	Values* determined Days	Values calculated Days	Values† determined Days	Values calculated Days
90		20	19		17
80		41	44	37	38
75		66	70	----	52
70		97	96	77	74
65		----	146	118	106
60			220		160
55		----	336	----	244
50		-	518	-	377
40		-	1,260	-	919

*Maximum length of storage before separation of resin-water solutions occurs when resin is subsequently diluted with water to 30 per cent resin concentration.
†Maximum length of storage before separation of resin-water solution occurs.

Table 3.—EFFECT OF INCREASED POLYMERIZATION OF A PHENOLIC RESIN* ON ITS ABILITY TO IMPART DIMENSIONAL STABILITY TO 3/16-INCH-THICK CROSS SECTIONS OF WOOD. DATA ARE THE AVERAGE OF VALUES FOR SEVEN SPECIMENS

Species	Resin concentration of treating solution† Per cent	Reduction in swelling‡ of wood treated with solution§ A-1 Per cent	A-2 Per cent	B-1 Per cent	B-2 Per cent	C Per cent	D Per cent
Mahogany	20	62.6	61.3	56.6	57.2	53.6	49.6
	25	66.2	65.1	66.2	61.6	56.7	51.9
	30	67.1	67.0	62.4	61.8	57.3	51.0
Birch	20	65.6	60.5	59.5	58.7	56.1	52.2
	25	67.8	65.7	63.2	62.7	60.4	56.2
	30	71.2	70.1	67.3	67.3	65.1	60.2
Average for each solution		66.7	64.9	62.5	61.5	58.2	54.6
Average for each state of polymerization		65.8		62.0		58.2	53.5
Per cent decrease		----		5.8		11.5	18.7

*Polymerization of resins was determined by their maximum dilutability with water.
†Per cent based on weight of resin as solids in total solution.
‡Based on swelling of untreated wood from oven-dry to water-soaked dimensions
§Resin designations are explained under the paragraph heading, "Determination of the Effect of Increased Polymerization of the Resins on their Ability to Stabilize Wood". Polymerization of resins increased from A to D.

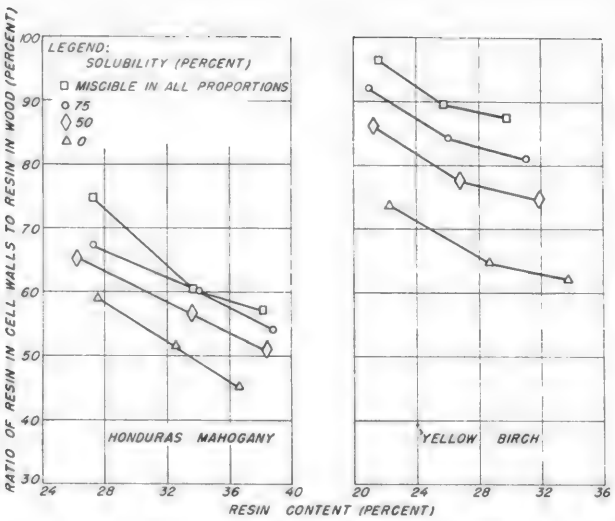

Fig. 6.—Relationship of the amount of resin in cell walls to the total amount of resin in wood impregnated with a phenolic resin at four stages of polymerization (as characterized by the solubility of water). The solubility of water is based on the total weight of the resin-water solution, and the resin content is based on the weight of oven-dry untreated wood.

total resin content but with resins of increasing degrees of polymerization is due to the deposition of a decreasing amount of resin within the cell walls.

Fig. 7 shows the relationship between volume of resin in the cell walls and volume increase from oven-dry to water-soaked condition. The values, in general, fall on a straight line which indicates that the swelling of wood decreases linearly with increasing volume of resin within the cell walls, at least in the range of this study. If it is assumed that the relationship can be extended to intercept both axes, then the point at which the curves intercept the *X* axis should indicate the volumetric swelling of wood (percentage) when the cell walls contain no resin (untreated wood). The point at which the curves cut the vertical axis should indicate the volume of resin in the cell walls (as a percentage of the untreated wood volume) when the cell walls can absorb no moisture (zero swelling). At this point, the cell walls are swollen by the resin to the same extent that the cell walls, in untreated wood, are swollen at the fiber saturation point. In Table 5 a comparison is made between the volumetric swelling of untreated wood in water (swelling in wood with zero per cent resin content) and the value calculated by extending the curves of Fig. 7 to the *X* axis. The values are in close agreement for mahogany; thus for this species the swelling in water is reduced by the volume of the resin in the cell walls. With birch, the calculated value is somewhat smaller.

Under stress-free conditions, each volume of water added to wood below the fiber saturation point adds its volume to the volume of the wood. The swelling is due to an enlargement of the cell walls. It is generally accepted that the cell walls have a limited enlargement capacity. If attempts are made to swell beyond this capacity, "ballooning" occurs. This analysis suggests that the role of the resin is simply to exclude moisture from the cell wall. The amount of moisture excluded is roughly equal to the volume of resin within the cell walls. If this analysis is correct, and if the stabilizing effectiveness curve (Fig. 7) is extrapolated to zero per cent swelling, the cell walls should be fully expanded because of the presence within them of a volume of resin equal to the volume of moisture present in wood at the fiber saturation point. The fiber saturation points for mahogany and birch are 25 and 30 per cent, respectively, on a weight basis or 10.8 and 20.4 per cent, respectively, on a volume basis (cc. g. 10.8 or 20.4 cc. per 100 cc. of dry untreated wood respectively). Table 6, column (6), gives the value for the fiber saturation point (volume basis) calculated from the intercept of the curves in Fig. 7 with the *Y* axis. Again the agreement is good for mahogany, but only fair for birch.

Analysis again suggests that the function of the resin within the cell wall is simply mechanical; it reduces the volume of the moisture that can be absorbed by approximately the volume of resin.

Table 4.—RESIN CONTENT OF 3/16-INCH-THICK CROSS SECTIONS OF TWO SPECIES OF WOOD IMPREGNATED WITH PHENOLIC RESIN AT FOUR STAGES OF POLYMERIZATION.* DATA ARE THE AVERAGE OF VALUES FOR SEVEN SPECIMENS

Species	Resin concentration of treating solution†	Resin content‡ of wood treated with solution§					
		A-1	A-2	B-1	B-2	C	D
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Mahogany	20	27.7	26.7	27.3	27.0	26.2	26.6
	25	34.0	33.6	34.0	33.9	33.6	32.5
	30	38.0	38.1	38.7	38.8	38.5	36.7
Birch	20	23.2	19.9	21.0	20.9	21.3	22.2
	25	26.8	24.7	25.9	26.1	26.8	28.6
	30	30.3	29.3	31.0	30.9	31.9	33.7
Average for each solution		30.0	28.7	29.7	29.6	29.7	30.0
Average for each stage of polymerization		29.4		29.7		29.7	30.0

*Polymerization of resins was determined by maximum dilutability with water.
†Per cent based on weight of resin as solids in total solution.
‡Based on weight of over-dry untreated wood.
§Resin designations are explained under the paragraph heading, "Determination of the Effect of Increased Polymerization of the Resins on their Ability to Stabilize Wood". Polymerization of resins increased from A to D.

Table 5.—COMPARISON OF VALUES FOR VOLUMETRIC SWELLING OF UNTREATED WOOD AS DETERMINED EXPERIMENTALLY AND FROM EXTRAPOLATION OF STABILIZING EFFECTIVENESS CURVE (Fig. 7) TO ZERO RESIN CONTENT IN CELL WALLS

Species	Swelling at zero resin content			
	Values determined by intercept of curve with x axis			
	Confidence limits			Experimental values
	Minimum	Maximum	Mean	
	Per cent	Per cent	Per cent	Per cent
Mahogany	10.5	13.5	11.6	11.0
Birch	16.5	19.7	17.8	21.6

Table 6.—COMPARISON OF VALUES FOR VOLUME OF RESIN IN CELL WALLS OF WOOD AS DETERMINED FROM INTERCEPT OF STABILIZING EFFECTIVENESS CURVE WITH Y AXIS (Fig. 7) AND VALUES CALCULATED FROM FIBER SATURATION POINT OF WOOD

Species	Estimated fiber saturation point Weight per cent	Specific gravity of untreated wood	Fiber saturation point by intercept of curve with y axis			Values calculated from fiber saturation point of wood Volume per cent
			Confidence limits			
			Minimum Volume per cent	Maximum Volume per cent	Mean Volume per cent	
Mahogany	25	0.433	10.0	12.0	11.0	11.8
Birch	30	.679	21.1	25.7	23.4	24.4

Summary and Conclusion

A relationship was found between storage temperatures of 65° to 90° F. and the length of time that a phenolic resin or resin-water mix can be stored and still be suitable for use in making impreg. Resins of various degrees of polymerization were prepared, and their effectiveness in imparting dimensional stability to wood was compared.

The storage life of phenolic resins or resin-water mixes depends primarily on the temperature of storage. The storage life can be more than doubled by reducing the temperature of the resin from 80° to 70° F., and more than tripled by reducing the temperature from 80° to 65° F. Whether the resins are stored after being mixed with water or without prior dilution does not significantly affect their subsequent miscibility. The practice of diluting the resins with water, therefore, has no advantage in increasing storage life. Resin solutions stored just under the maximum storage time are only approximately 6 per cent less effective in imparting dimensional stability to wood than are solutions prepared from freshly made resins. The only requirement, then, for the phenolic resins for making impreg is that they be capable of being diluted with water to the resin concentrations desired. The degree of stabilization of wood by impregnation with phenolic resin is dependent on the amount of resin deposited in the cell walls. In general, for a given resin content, the amount of resin deposited in the cell walls decreases with increased polymerization of the resin.

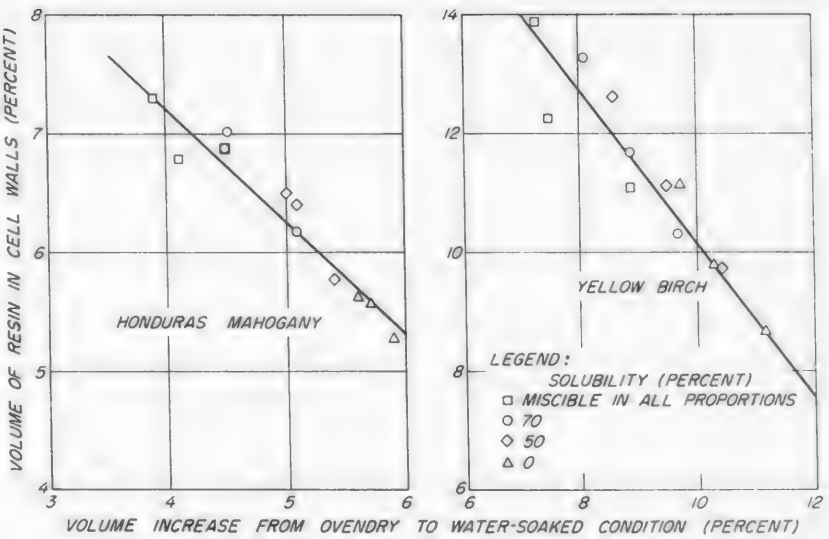

Fig. 7.—Effect of resin in cell walls on the swelling of wood impregnated with a phenolic resin at four stages of polymerization (as characterized by the solubility of water). The solubility of water is based on the total weight of the resin-water solution, and the volume of resin in the cell walls and the volume increase of treated wood are based on the volume of the oven-dry untreated wood.

Dimensional Stabilization of Wood[1,2] Part III. Butylation

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Butylation with n- and t-butyl chlorides imparts stability to the dimensions of wood on a temporary basis only. Although the alkylating agents used are relatively inexpensive petrochemicals, butylation seems to be of little value for chemical seasoning as shown from the results of this study.

Theoretical and Historical

IN ADDITION TO ESTERIFICATION, alcoholic hydroxyls may participate in a second type of reaction called etherification. The general method of ether formation is first the preparation of an alkali alkoxide which in turn reacts with an alkyl halide or sulfate, yielding an ether. Thus,

$$ROH + NaOH \longrightarrow RONa + H_2O$$
$$RONa + R'X \longrightarrow ROR' + NaX$$

where R may represent a lignin residue, a polysaccharide chain, or any other organic radical; R' may represent any organic radical; and X, a halide or sulfate radical.

A vast majority of reported work (2, 3, 8, 9, 13)[4] uses sodium hydroxide as the alkali. The alkylating agent is an alkyl halide, sulfate or phosphate.

Alkalis other than sodium hydroxide have been used including thallium hydroxide (4), potassium hydroxide and a sodium hydroxide-cupric hydroxide mixture (10), and quaternary bases of higher molecular weights (10). Sodium or sodamide in liquid ammonia has been employed by Barry et als. (1) while Lolkema (7) has patented the use of ammonium hydroxide in the etherification of starch.

The use of sodium hydroxide is not advised in the etherification of wood because of its degrading effect upon the latter. Prelimary trials using ammonium hydroxide as the alkali failed to yield the desired reaction with wood. Preliminary runs indicated that pyridine could be used. The following work is a study of etherification of wood using pyridine as the swelling agent and catalyst, with 1-chlorobutane (n-butyl chloride) and 2-chloro-2-methylpropane (t-butyl chloride) as alkylating agents.

Experimental

The influences of various factors upon the weight increases of wood resulting from introduced groups were

[1] ... is the third of a series of five articles. ... appeared in the June issue, Part II. ... July issue.

[2] ... paper constitutes part of a thesis sub... by D. F. Arseneau in partial fulfillment ... requirements of the degree of D. Sc. in ... try, Graduate School, Laval University, ... 1955. Financial assistance was given to ... seneau by the Shell Oil Co. and the ... Scientific Research Bureau.

[3] This paper was prepared while Dr. Arseneau was a graduate student at Laval. He is now on the staff of the Dept. of Chemistry, Xavier Junior College, Sydney, N. S., Canada.

[4] Numbers in parentheses refer to Literature Cited.

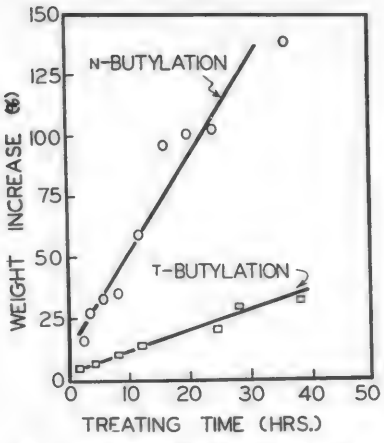

Fig. 1.—Relation between treating time and weight increase of balsam fir wafers upon butylation.

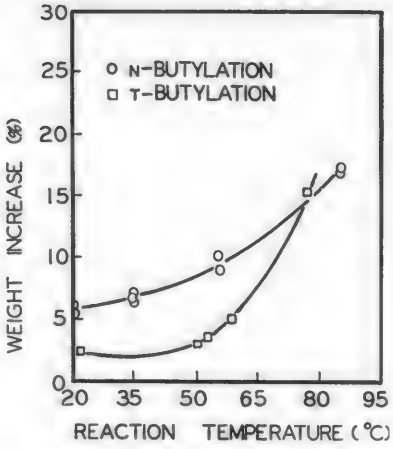

Fig. 2.—Relation between reaction temperature and weight increase of balsam fir upon butylation.

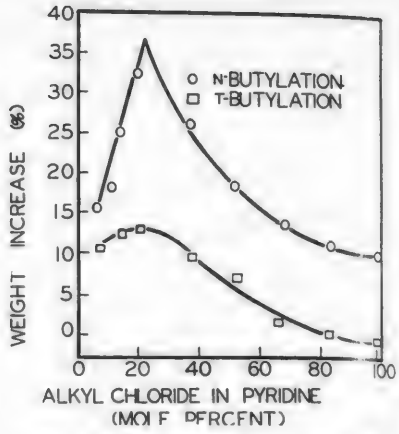

Fig. 3.—Relation between the composition of treating solution and the weight increase of balsam fir wafers upon butylation.

studied in order to determine optimum conditions for the butylation treatments and also to ascertain the mechanism of the treatments. In all butylation treatments wafers of balsam fir measuring. 1–1½ inch longitudinally and 1½ inch in diameter were used.

A– Treating Time

a- n-Butylation: Balsam fir wafers were swollen in reagent grade pyridine for six hours at room temperature and then air-dried for 30 minutes. The swollen samples were placed in a treating solution composed of three parts by weight 1-chlorobutane and one part pyridine, and heated to reflux. For this solution, reflux temperature was 85° C. Samples were thus treated for 2, 4, 8, 12, 16, 20, 24, 28 or 36 hours then dried at 110° C. for 18 hours. When cooled each was weighed and measured.

b- t-Butylation: For a liquid-phase butylation, oven-dry wafers were soaked for 24 hours in a 35-per cent by weight solution of 2-chloro-2-methylpropane in pyridine. The samples were then placed in a similar solution and refluxed for 2, 4, 8, 12, 16, 20, 24, 28 or 36 hours. They were dried at 110° C. for 18 hours, cooled, weighed and measured.

For a vapor-phase butylation, the wafers were soaked in a solution of 35-per cent by weight of 2-chloro-2-methylpropane in pyridine for six hours. The solution was evaporated from the coarse capillary structure of the wood under reduced pressure. The samples were then subjected to the vapors of a refluxing solution of above composition which all of the time was warmed to 65° C. with a heat lamp. Treating times were 7, 24, 48 or 64 hours. Treatment was followed by drying at 100° C. for 18 hours. When cooled, the samples were weighed and measured.

B– Reaction Temperature

a- n-Butylation: The wafers were placed in solutions consisting of three parts by weight 1-chlorobutane in one part pyridine. After a swelling period of six hours, the various solutions were heated to the following temperatures: 20, 35, 55 and 85° C. Treating time was 24 hours. The samples were then dried at 110° C. for 18 hours, cooled, weighed, and measured.

b- t-Butylation: The samples were soaked in a 50-percent solution of 2-chloro-2-methylpropane in pyridine for two hours. After this swelling period, they were placed in individual solutions of the above concentration which were heated to the following temperatures: 22, 50, 52, 58, and 77° C., the last one being the reflux temperature of the solution.

C– Composition of the Treating Solution

a- n-Butylation: The wafers used in this series of tests were soaked in pyridine for 17 hours and air-dried for one and one-half hour. Each of these wafers was placed in 50 ml. of a solution of 1-chlorobutane in pyridine of known concentration. The solutions were refluxed for six hours. After treatment the samples were dried at 100° C. for six hours. When cooled, they were weighed and measured. The concentrations of the solutions used were: 7.5, 15, 22.5, 35, 55, 70, and 85-percent by weight of 1-chlorobutane in pyridine, and pure 1-chlorobutane.

b- t-Butylation: The wafers were placed in solutions of 2-chloro-2-methylpropane of various compositions, 50 ml. of solution being used. Soaking was continued for 17 hours. The samples and their treating solutions were then heated to reflux and held there for six hours. After treatment, they were dried at 100° C. overnight. When cooled, they were weighed and measured. The composition of the solutions was again 7.5, 15, 22.5, 35, 55, 70, and 85-percent by weight 2-chloro-2-methylpropane in pyridine, and pure 2-chloro-2-methylpropane.

D– Repeated n-Butylation Treatments

The wafers to be treated were soaked overnight in a solution of 20 percent 1-chlorobutane in pyridine. After this swelling period they were heated to the reflux temperature of the treating solution for a period of one-half hour. They were then placed in a covered beaker and heated at 100° C. for six hours. The purpose of this technique was to prevent excess cracking of the wood due to too rapid a drying. The samples were next placed in an oven for normal drying at 100° C. for a few more hours. When cooled, the wafer requiring no further treatments was weighed and measured. The remaining samples were resoaked and the entire procedure repeated, at each repetition one extra sample being left out. Samples received from one to five such treatments.

Results

A– Treating Time

Fig. 1 shows the relationship between the treating time and the resulting weight increase of the butylated samples, based on the oven-dry untreated weights. The relationship is linear for both types of butylation the slope however being five times greater for n-butylation than for t-butylation. Fig. 4 shows the effect of treating time upon the antishrink efficiencies (A.E.'s) imparted to the samples by butylation. Increases in A.E.'s with treating time are again more rapid for n-butylation than for t-butylation The difference here however is much less than the corresponding difference in

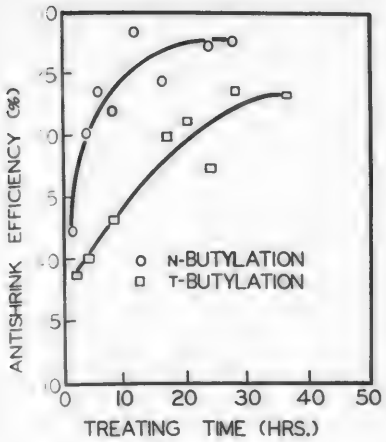

Fig. 4.—Relation between treating time and antishrink efficiency of balsam fir wafers upon butylation.

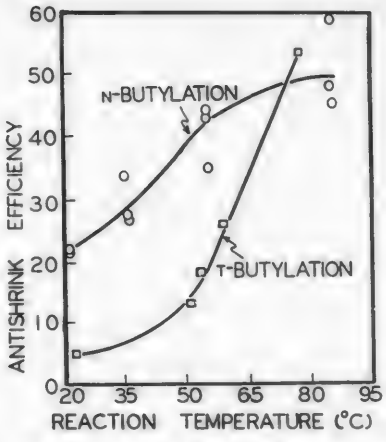

Fig. 5.—The effect of reaction temperatures upon the antishrink efficiency imparted to balsam fir wafers upon butylation.

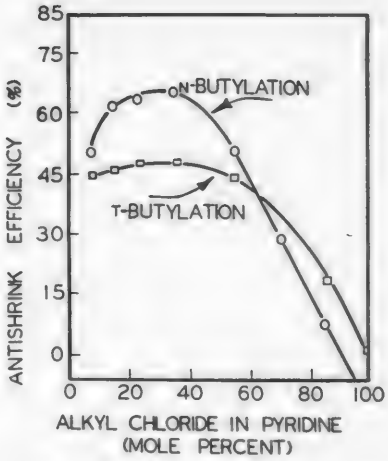

Fig. 6.—The effect of composition of treating solution upon the antishrink efficiency imparted to balsam fir wafers upon butylation.

weight-increases by the two methods. Table 1 shows the relationship between the treating time and resulting weight increases in t-butylation by the vapor-phase procedure.

Table 1.—RELATIONSHIP BETWEEN TREATING TIME AND WEIGHT INCREASES OF BALSAM FIR WAFERS t-BUTYLATED BY THE VAPOR-PHASE METHOD

Treating Time Hours	Weight Increase %
7	9.9
7	10.1
24	13.5
24	16.2
48	18.8
48	28.3
64	29.9
64	33.1

B– Reaction Temperature

Fig. 2 illustrates the effect of temperature upon the percent weight increase of wood based upon the oven-dry untreated weight. Fig. 5 relates temperature to the A.E.'s of the treated wood. In both instances the preferred reaction temperature is the reflux temperature of the solution. The wood is not noticeably degraded at these temperatures.

C– Composition of the Treating Solution

Fig. 3 relating the composition of the treating solution to the percent weight increase of the wood over its oven-dry untreated weight shows that a maximum is attained at about 20 mole percent of the alkyl chloride in pyridine, that is, one molecule of alkyl chloride to four of pyridine, in both types of butylation. Fig. 6 relating composition to A.E.'s shows the maximum to be spread between 20 and 40 mole percent of alkyl chloride.

D– Number of Repeated n-Butylation Treatments

Table 2 shows that for n-butylation, maximum weight increase and maximum A.E. are reached with two identical treatments. Further repetition of the teratment decreases both the weight increase and the A.E.

Table 2.—EFFECT OF THE NUMBER OF n-BUTYLATION TREATMENTS UPON THE WEIGHT INCREASE AND ANTISHRINK EFFICIENCY OF BALSAM FIR WAFERS

Number of Treatments	Weight Increase %	Antishrink Efficiency %
1	7.6	40.3
2	11.0	45.0
3	9.8	34.0
4	8.9	31.8
5	5.7	36.2

E– Humidity Studies

A study of the mechanism of dimensional stabilization by butylation methods may be made through a consideration of the hygroscopic characteristics of butylated wood. Figs. 7 to 12 are the results of such a study. Fig. 7 shows the percent moisture content of balsam fir wafers, n-butylated to various degrees, when they are subjected to different relative humidities. Fig. 9 shows the same thing for t-butylated balsam fir. Figs. 8 and 10 show the percent tangential swell of n-butylated and t-butylated samples resulting from various moisture contents. Finally, Figs. 11 and 12 show the actual swelling of butylated samples when subjected to varying relative humidities.

Discussion

This study indicates that dimensional stabilization by butylation methods is effected by two factors: (a) the bulking effect of a pyridinium alkyl chloride salt; and (b) the deposition of an hygroscopic salt within the wood structure.

The bulking effect is clearly illustrated by Figs. 8 and 10. At low moisture contents, the percent swell is about the same for all samples. At about 10 or 15 per cent moisture content, the swelling is contained, the curves levelling off. The greater the butyl content (i.e n-butyl pyridinium chloride or t-butyl pyridinium chloride), the less is the swelling permitted.

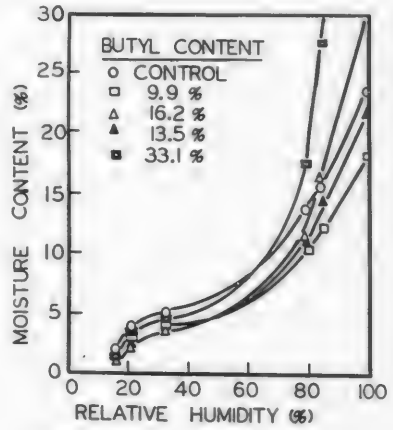

Fig. 7.—Relation between relative humidity and moisture content of balsam fir wafers after n-butylation.

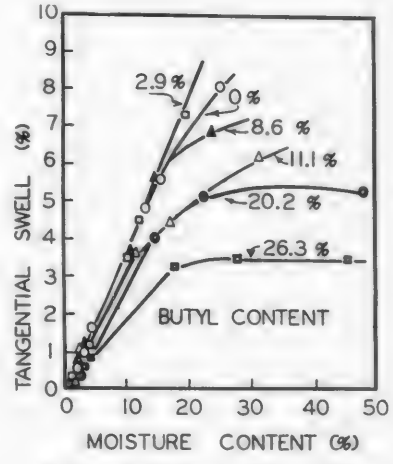

Fig. 8.—Relation between the moisture content and the tangential swell of balsam fir wafers after n-butylation.

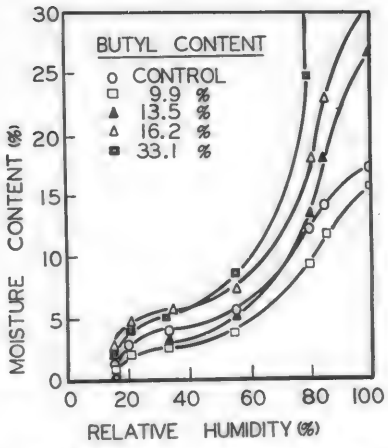

Fig. 9.—Relation between relative humidity and moisture content for balsam fir wafers after t-butylation.

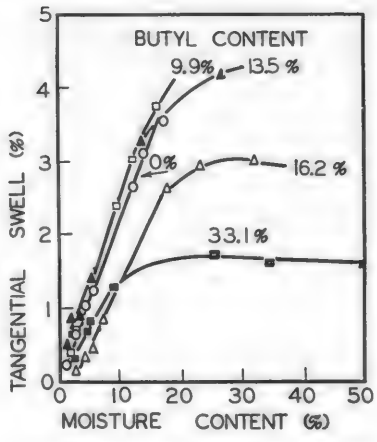

Fig. 10.—Relation between moisture content and tangential swell of balsam fir wafers after t-butylation.

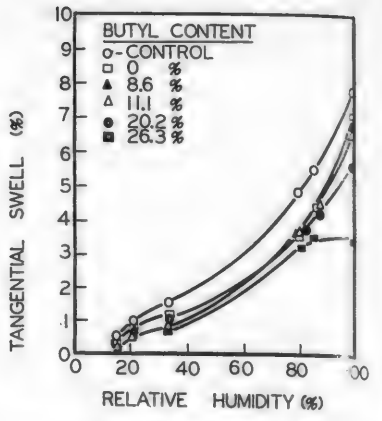

Fig. 11.—The per cent tangential swell of n-butlylated balsam fir resulting from relative humidity changes.

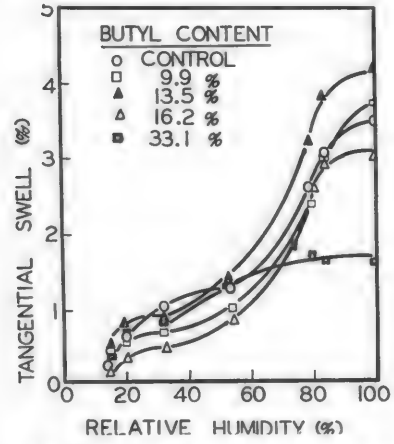

Fig. 12.—The per cent tangential swell of t-butylated balsam fir resulting from relative humidity changes.

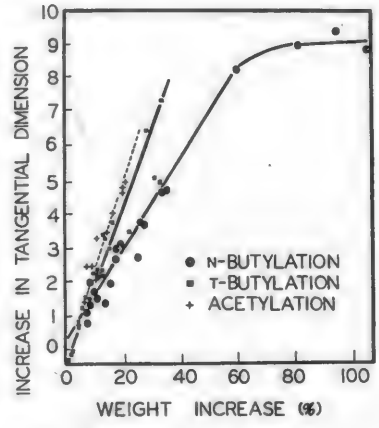

Fig. 13.—Relation between weight increase upon butylation and the per cent increase of oven-dry tangential dimension.

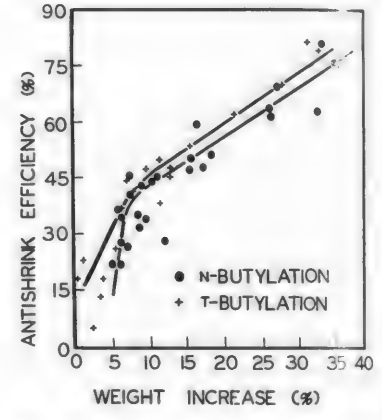

Fig. 14.—Relation between weight increase and the resulting antishrink efficiency of balsam fir with butylation.

The equilibrium relative vapor pressure above a saturated solution of the pyridinium salt of n-butyl chloride was found to be about 57 per cent at room temperature. It could therefore be expected that as the atmospheric R.H. exceeded 57 per cent, a sharp increase in the gain in moisture content would be observed. Fig. 7 shows this to be true. Also as would be expected, the greater the butyl content then the greater is the moisture absorbed. Previous workers have found evidence of similar behavior when salts (11), sugars (12), and a pyridinium-allyl chloride polymer (5, 6) were deposited in the wood. Attempts to determine the equilibrium R.H. above a saturated solution of the pyridinium salt of the tertiary butyl chloride were unsuccessful.

When n-butylated samples were water leached, the pyridinium salt of 1-chlorobutane was partially recovered from the leach water. Attempts to recover a similar salt from the water used to leach t-butylated samples failed. When humidity studies were being made on the t-butylated wafers, pyridine was found to be evolved, possibly because of an hydrolysis of the pyridinium salt. Leaching with water for seven days failed to remove all the substance introduced into the wood upon butylation.

Because of its branched chain, the 2-chloro-2-methylpropane salt of pyridine would be expected to be more bulky than the corresponding 1-chlorobutane salt. This would explain notable differences in the two reactions. Fig. 13, relating weight increase of the sample with the resulting tangential swell-upon-treatment, shows that for any given percent weight increase of a sample, the oven-dry treated tangential dimension is less for the n-butylated wood than for the t-butylated one. This effect is shown also in Fig. 14 which relates A.E. to weight increase for n-butylated and t-butylated wood. For any given weight increase in a butylated sample, the t-butylated sample exhibits the greater A.E. The volume difference explains why in the studies of optimum reaction conditions, less salt was introduced into the wood by t-butylation methods than by n-butylation methods.

Figs. 11 and 12 show the changes experienced by butylated wood during changes in humidity.

Conclusion

Both methods of butylation studied impart stability to the dimensions of wood on a temporary basis only. Although the appearances of the wood are not greatly changed, its strength may be expected to be decreased because of the permanently damp condition of the wood at the humidities most often encountered in everyday use.

The stabilization mechanism places the two methods of butylation in the same class as the procedures used for chemical seasoning which employed sugars (12) and salt (11). Although the alkylating agents used are relatively inexpensive petrochemicals, butylation seems to be of little value for chemical seasoning.

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Permeability of Wood and Other Cellulose Products to Ethylene Oxide Gas

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A test was made of the permeability of several cellulose materials to ethylene oxide gas. It would be possible to fumigate packaged products in storage if the packing material is permeable to the gas.

As ETHYLENE OXIDE is used as a fumigant and a decontaminating agent[1], it is advisable to know the penetration of this compound in the gaseous state through packing materials such as wooden boxes, cardboard, paper, etc. If the packing material is permeable to the gas, it would be possible to fumigate package materials in storage.

To test for penetration of the ethylene oxide gas through materials, the gas was passed over one side of the material, tightly clamped between two metal chambers, while dry air was passed over the other side of the material. This air would then pick up any ethylene oxide which might come through the material. The air containing the gas was then passed through a bubbler containing the reagent with a colorimetric indicator for the determination of ethylene oxide. The two metal chambers tightly clamped together are considered as an H-cup.

The experimental conditions for penetration determinations were at laboratory temperatures (65°–85° F.), air flow of ½ liter per minute, differential pressure across material positive to ethylene oxide of 3 mm. mercury in a manometer connected across the H-cups.

The reagent in the bubbler was 25.0 ml of 0.015 N sulfuric acid saturated with magnesium bromide. This is essentially the reagent suggested by Siggia[2] modified by Phillips and Kaye[3]. Bromcresol purple was used as the indicator. This was found to be more satisfactory than methyl orange because of a shorter resolving time and a more definite change of color.

[1] Phillips and Kaye. 1949. The sterilization action of gaseous ethylene oxide. The American Jour. of Hygiene 50:270–279.

[2] Siggia. 1954. Quantitative organic analysis via functional groups. John Wiley & Sons, Inc., New York City. 2nd ed. 157–158.

[3] Op. cit.

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D. R. Osgood, a graduate of Massachusetts Institute of Technology, received M.A. from Florida State University. He is now working as a chemist in the field of radioisotopes at the U. S. Veterans Administration Hospital, Coral Gables, Fla.

Table 1.—PERMEABILITY OF WOODS TO ETHYLENE OXIDE

Poplar	0.010 mg/min/H-cup =	0.24 mg/min/sq ft
Oak	0.023 mg/min/H-cup =	0.55 mg/min/sq ft
Maple	0.026 mg/min/H-cup =	0.62 mg/min/sq ft
Mahogany	0.033 mg/min/H-cup =	0.79 mg/min/sq ft
White Pine	0.042 mg/min/H-cup =	1.01 mg/min/sq ft
Magnolia	0.064 mg/min/H-cup =	1.54 mg/min/sq ft
Yellow Pine	0.120 mg/min/H-cup =	2.52 mg/min/sq ft
Walnut	0.135 mg/min/H-cup =	2.84 mg/min/sq ft
Cypress	0.635 mg/min/H-cup =	15.24 mg/min/sq ft
Plywood, Fir (3 ply)	0.052 mg/min/H-cup =	1.25 mg/min/sq ft

Table 2.—PERMEABILITY OF MANUFACTURED MATERIALS TO ETHYLENE OXIDE

Linoleum	0.052 mg/min/H-cup =	1.25 mg/min/sq ft
"Transite"	0.72 mg/min/H-cup =	17.3 mg/min/sq ft
"Masonite"	3.56 mg/min/H-cup =	85.4 mg/min/sq ft
Cardboard	8.90 mg/min/H-cup =	213.6 mg/min/sq ft

Table 3.—PERMEABILITY OF PAPERS TO ETHYLENE OXIDE

Plain Paper	211.2 mg/min/sq ft average of 20 samples
Kraft Paper and Thin Cardboard	580. mg/min/sq ft average of 6 samples
Coated Papers	8.2 mg/min/sq ft average of 20 samples
Laminated Metal Foil Papers	0.72 mg/min/sq ft average of 10 samples

Comparison of the samples for penetration of the gas was made on the basis of penetration of milligrams of ethylene oxide per minute. The samples of wood were all smooth face grain without knots, 1/4 inch x 4 inches x 4 inches. These were used in the H-cup, with nylon gaskets, except in the case of oak where linoleum gaskets were used. Penetration of the gas was across the fibers, perpendicular to the grain. The experimental exposure time was 30 minutes for each sample noted in Table 1. This was not necessarily an equilibrium time but did allow for a comparison of penetration of the gas under like conditions.

The permeability of other materials which are used instead of wood is given in Table 2. All of these samples were of the same thickness and surface area as the wood samples.

It might be of interest to note qualitative results with a group of other cellulose products as given in Table 3. This group was variable in thickness and composition. One might draw the conclusion that paper and cardboard, plain and corrugated, allow rapid penetration of ethylene oxide gas. Coated papers are quite variable but, in general, are more resistant to penetration than uncoated papers.

For all practical purposes a permeability of less than 3 mg/min/sq ft of ethylene oxide gas through materials is considered negligible. All of the woods except cypress and the laminated metal foil papers come within this range. It is interesting to note that linoleum and 3-ply fir plywood offer the same resistance to the penetration of the ethylene oxide gas.

A material which prevents penetration of the ethylene oxide gas will, of course, be a good barrier to prevent the escape of the gas in packaged materials.

Durability of Urea-Resin Glues at Elevated Temperatures[1]

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A study was undertaken of the performance of several types of urea-resin glue formulations in continuous exposure at 80°, 120°, 140° and 158° F. Eleven glues were studied, including powdered, high- and low-solids liquid resins, with and without wheat flour extender, and cured both in hot presses and at room temperature. Data are reported for the first three years of exposure.

Introduction

DATA PREVIOUSLY REPORTED[3] indicated that urea-resin glue joints in yellow birch plywood cured at room temperature were seriously weakened by continued exposure to elevated temperatures (158° and 200° F.). In continuous exposure to 158° F., urea-resin glue joints lost about 75 per cent of their initial strength in 30 months. Similar joints lost almost all their strength in 6 months' exposure to 200° F. The same trends, but somewhat less rapid, were noted for several hot-press, urea-resin glues. Continuous exposure to these temperatures is admittedly severe. Urea-resin glues, however, are being used in products which are subjected to intermittent high temperatures, such as radio and television cabinets, and they are being considered for use in laminated members, and plywood sheathing for walls and roofs where considerable intermittent heating may be expected in service. Use in housing demands a more durable glue joint than other products may require. Safety considerations and high replacement costs of unsatisfactory materials are important considerations.

Data of actual temperatures likely to be encountered in glue joints of plywood in housing applications are very meager now. Temperature measurements at several locations in the roof of a typical two-story new house in Madison, Wis., were made with thermocouples and a continually recording potentiometer during the summer of 1954. This was a relatively cool summer. Temperatures between the lower surface of roof sheathing boards and the top edge of the roof rafters were as high as 150° F., and for several days, during which continuous measurements were made, this temperature was more than 100° F. for 8 to 10 hours a day, more than 125° F. for as much as 6½ hours a day, and more than 135° F. for as much as 5 hours a day. Corresponding temperatures between tan asphalt shingles and the top surface of the roof sheathing on the same areas of roof reached a maximum of 166° F., and on an average summer day this temperature was more than 140° F. for 6 hours out of 24, and for 3 hours of the 24 was at 160° F. or higher. Air temperatures, reported by the weather bureau, during these periods never exceeded 100° F. These tests did not include temperature measurements in actual glue lines, but the temperatures noted may indicate temperatures likely in roof sheathing plywood. In warmer climates than Wisconsin, even higher temperatures and longer periods of exposure may be expected.

Very limited records of temperatures in one white-painted conventional stud wall section in Madison indicate that, during a typical summer, temperatures between the outside sheathing and the outer stud face are much lower than those on roof joints and generally follow quite closely outside air temperatures.

Data were lacking on the performance of urea-resin glues at temperatures

[1] Presented at Session V, Glues and Gluing, FPRS Tenth National Meeting, June 4-7, 1956, in Asheville, N. C.

[2] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[3] Durability of water-resistant woodworking glues. Forest Products Laboratory Report 1530, Revised September 1956.

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Warren Z. Olson received B.S. degree from the University of Wisconsin. He is engaged in research in the properties and characteristics of wood glues and has authored several FPL publications.

tures between 80° F. and 158° F., the range of more direct interest for many applications of urea-resin glues. Since previous data on effects of elevated temperatures were limited to performance of yellow birch plywood specimens, additional information was desired on a lower density veneer species and on laminated joints of lumber. The tests reported here were made to obtain more extensive knowledge of the effect of heat on urea-resin glue joints to produce a sound basis for recommendations regarding products in which urea-resin glue may be used.

Plywood of two hardwood species was prepared for this work. Eleven different urea-resin glues were used in birch plywood and 5 in sweetgum plywood. Four of these glues were also used in hard maple, block-shear test specimens to furnish strength data at a higher level. The glues included high solids and low solids, liquid resins and powdered resins, a fortified liquid resin, and a compensated or non-crazing resin. These glues were all commercial formulations prescribed by glue manufacturers and were selected to represent a variety of types for both hot and cold pressing.

Procedures

The types of glues used are given in Table 1. Yellow birch plywood panels were prepared with all of the glues, sweetgum panels with glues A, B, D, F, and G, and maple-block joints with glues A, G, H and J. The gluing conditions are given in Table 2. The glues were prepared according to directions of the manufacturers, and gluing conditions used were within ranges specified by them.

All plywood panels prepared at room temperature were 5 by 12 inches, and the hot-pressed panels were 12 by 12 inches. Twenty-five to 32 panels were made with each room temperature glue and 8 to 10 panels with each hot-press glue. Each panel consisted of three plies of 1/16-inch veneer. Standard shear-test specimens were cut from the panels after at least one week of conditioning at 80° F. and 30 per cent relative humidity. Specimens randomly selected from each panel were then tested dry to obtain an average initial shear strength value for each glue.

Maple block-shear test specimens were obtained from small beams prepared by gluing together six ¾- by 2½- by 13-inch laminations. Gluing conditions are included in Table 2. Five step-wise specimens (Fig. 1), each with 5 glue lines were cut from each beam after conditioning at least one week at 80° F. and 30 per cent relative humidity. One step-wise specimen from each of the five beams made with each glue was tested before exposure to obtain an average block-shear strength control value.

The plywood and block-shear specimens remaining after control tests, were randomly distributed into a number of representative groups, and each group was then exposed continuously under one of the following conditions. The approximate equilibrium moisture content values that wood might reach in each exposure are given in parentheses:

1. 80° F. and 30 per cent relative humidity (6 per cent)
2. 80° F. and 65 per cent relative humidity (12 per cent)
3. 120° F. and 28 per cent relative humidity (5 per cent)
4. 140° F. and 25 per cent relative humidity (4 per cent)
5. 158° F. and 20 per cent relative humidity (3 per cent)

Exposures 1 and 2 were in large conditioning rooms with automatic mechanical temperature and relative humidity control. Exposures 3, 4, and 5 were in exposure test chambers with automatic electrical heating and with humidification supplied with selected saturated salt solutions. Exposure 5 was in the same chamber that had been used in many earlier high-temperature exposures at the Laboratory.[4]

Yellow birch plywood specimens made with all of the glues were subjected to exposures 2, 3, 4, and 5. Birch specimens made with glues A, B, C, D, F, and G, were also subjected to exposure 1. This additional exposure was selected to provide data on the effect of two humidity conditions at one temperature. Sweetgum plywood specimens made with glues A, B, D, F, and G were subjected only to exposures 2, 3, and 5. Hard maple block-shear specimens were made with glues A, G, H, and J were subjected to exposures 2, 3, 4, and 5.

At intervals of six months, randomly selected groups of five birch and five sweetgum test specimens were taken from each exposure and tested by ASTM Method D906–49. At intervals of 12 months, one maple step-wise shear specimen made with each glue was taken from each exposure and tested according to ASTM Method D905–49. All specimens removed from the elevated temperature exposures were immediately placed in a small closed container and cooled to room temperature before testing. This was done to keep moisture contents before testing close to those of exposure. Tests were always made within one hour after removal from exposure chambers.

Results and Discussion

The results of tests made at intervals are shown graphically in Figs. 2 through 6. In these figures, the control strength values for plywood specimens are averages of 16 to 30 ran-

[4] See footnote 3.

Table 1.—TYPES OF UREA-RESIN GLUES* USED IN STUDY OF DURABILITY OF PLYWOOD OR BLOCK JOINTS AT ELEVATED TEMPERATURES

Glue	Type
	CURED at 75° F. FOR 18 TO 24 HOURS
A	65 per cent solids, liquid resin, unextended
B	65 per cent solids, liquid resin, 82 per cent wheat flour†
E	50 per cent solids, liquid resin, 84 per cent wheat flour†
G	Powdered resin, unextended
H	Powdered resin, unextended
J	Liquid resin, noncrazing type
K	Liquid resin, fortified‡
	CURED AT 240° F. FOR 8 MINUTES
C	65 percent solids, liquid resin, unextended
D	65 per cent solids, liquid resin, 120 per cent wheat flour†
F	50 per cent solids, liquid resin, 120 per cent wheat flour†
I	Powdered resin, unextended

*All formulations were as prescribed by glue manufacturers.
†Expressions are based on weight of dry resin solids. (Moisture content of wood when glued = approximately 6 per cent.)
‡This was a commercial formulation, intended only for room-temperature curing. The type and amount of fortification were not determined.

Table 2.—GLUING CONDITIONS* USED FOR PREPARING PLYWOOD AND BLOCK SHEAR SPECIMENS

Glue	Type	Wheat flour Per cent‡	Glue spread (average) Lb. per 1,000 sq. ft.	Assembly time (closed) Min.	Curing conditions		
					Pressure P.s.i.	Temperature °F.	Time†
			PLYWOOD				
A	65 per cent solids, liquid	0	43	7–10	150	75	18–24 hours
B	65 per cent solids, liquid	82	53	7–10	150	75	18–24 hours
E	50 per cent solids, liquid	84	55	7–10	150	75	18–24 hours
G	Powder	0	45	7–10	150	75	18–24 hours
H	Powder	0	45	7–10	150	75	18–24 hours
C	65 per cent solids, liquid	0	42	8	150	240	8 minutes
D	65 per cent solids, liquid	120	55	7	150	240	8 minutes
F	50 per cent solids, liquid	120	55	7	150	240	8 minutes
I	Powder	0	35	8	150	240	8 minutes
J	Liquid, noncrazing	0	44	7–10	150	75	18–24 hours
K	Liquid, fortified	0	45	7–10	150	75	18–24 hours
			MAPLE BLOCKS				
A	65 per cent solids, liquid	0	47	9	200	75	18–24 hours
G	Powder	0	46	10	200	75	18–24 hours
H	Powder	0	51	10	200	75	18–24 hours
J	Liquid, noncrazing	0	44	10	200	75	18–24 hours

*Moisture content of all wood was approximately 6 per cent when glued.
†All specimens were conditioned for at least seven days at 80° F., 30 per cent relative humidity before testing.
‡Based on weight of resin solids.

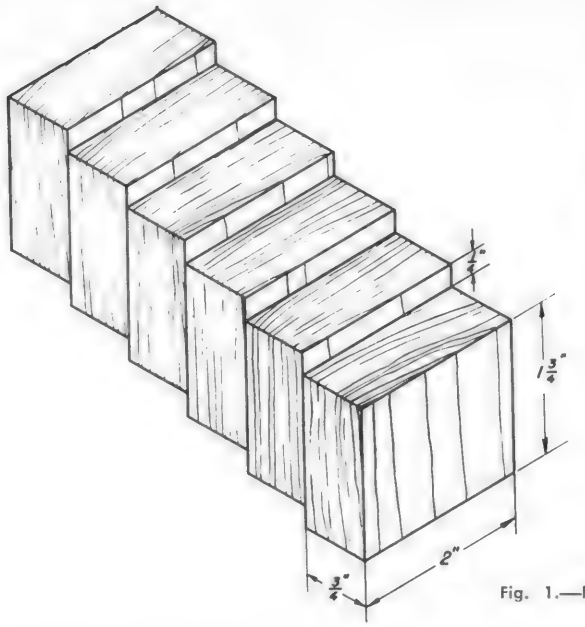

Fig. 1.—Diagrammatic sketch of stepwise shear-test specimens from small laminated hard maple beam.

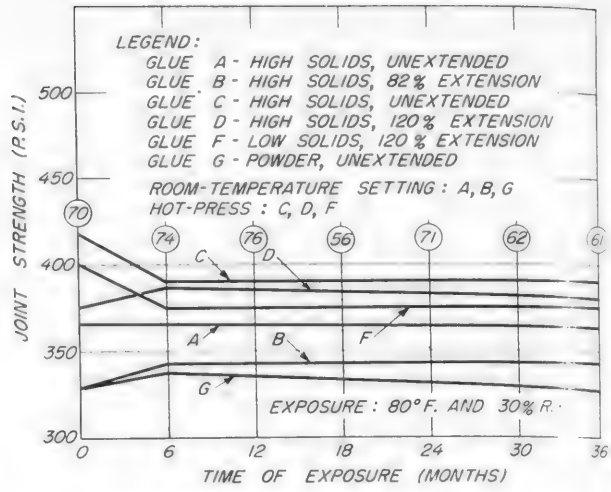
LEGEND:
GLUE A - HIGH SOLIDS, UNEXTENDED
GLUE B - HIGH SOLIDS, 82% EXTENSION
GLUE C - HIGH SOLIDS, UNEXTENDED
GLUE D - HIGH SOLIDS, 120% EXTENSION
GLUE F - LOW SOLIDS, 120 % EXTENSION
GLUE G - POWDER, UNEXTENDED
ROOM-TEMPERATURE SETTING : A, B, G
HOT-PRESS : C, D, F
EXPOSURE : 80° F. AND 30% R.H.
JOINT STRENGTH (P.S.I.)
TIME OF EXPOSURE (MONTHS)

Fig. 2.—Yellow birch plywood specimens made with six urea-resin glues. Circled values are average wood failure percentages.

domly selected specimens, and values after exposure are averages of five specimens. Control strength values for block-shear tests (Fig. 6) are averages of 25 individual values (five joints in each of five step-wise specimens). Values after each exposure period are averages for five individual values (five glue lines in one step-wise specimen). The actual average test values are plotted directly for the controls. Control specimens had approximately 6 per cent moisture content when tested. Specimens after six months' exposure to 80° F. and 65 per cent relative humidity would have approximately 12 per cent moisture content. After six months at 80° F. and 30 per cent relative humidity, specimens still would have a moisture content of approximately 6 per cent. After exposure to higher temperatures, moisture contents were still lower. Previous work showed that the joint strength values of yellow birch plywood, glued with a hot-press melamine-resin glue, decreased as the moisture content of the specimen at the time of the test decreased below 12 per cent.[5] Consequently, the changes observed in the first six months of exposure are probably due mainly to these moisture content changes in the specimen in addition to any effect of exposure.

For the plywood shear-test data, actual test averages after 6 through 36 months' exposure were plotted separately for each glue, and smooth curves were drawn through these points. These curves are shown in Figs. 2 through 5 for exposure from 6 to 36 months. Data for block-shear tests are

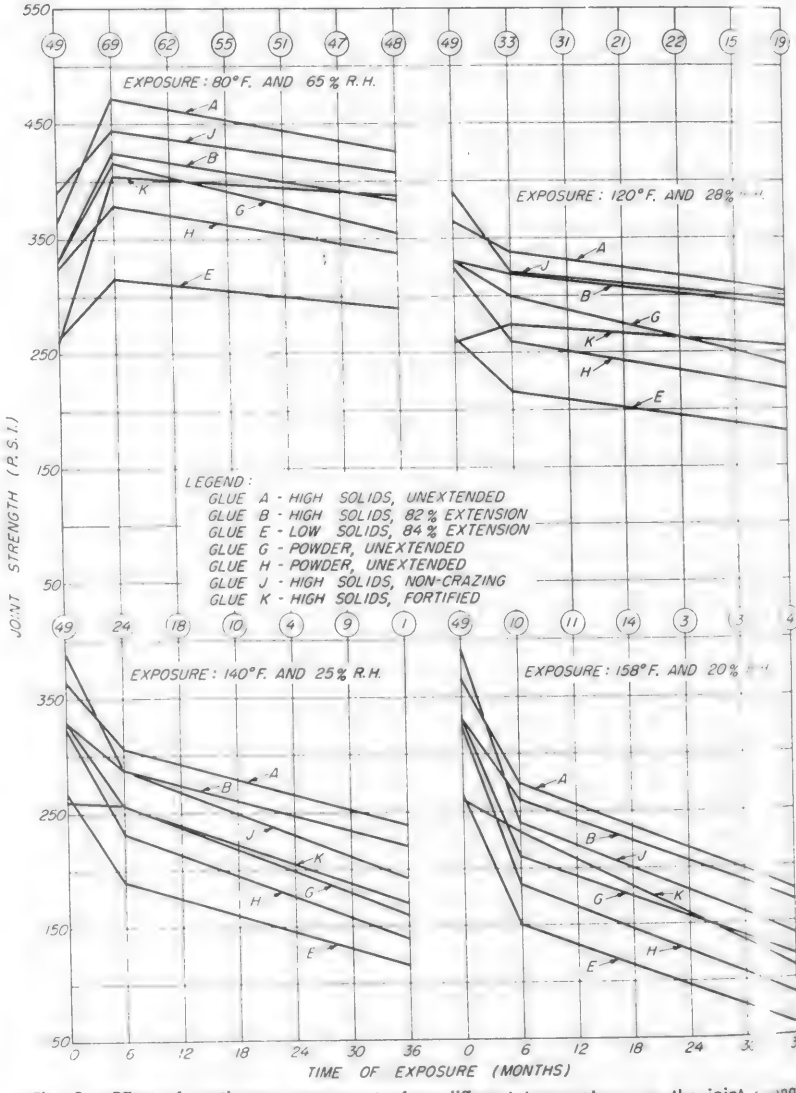
EXPOSURE : 80° F. AND 65 % R.H.
EXPOSURE : 120° F. AND 28%
EXPOSURE : 140° F. AND 25 % R.H.
EXPOSURE : 158° F. AND 20%
LEGEND :
GLUE A - HIGH SOLIDS, UNEXTENDED
GLUE B - HIGH SOLIDS, 82% EXTENSION
GLUE E - LOW SOLIDS, 84 % EXTENSION
GLUE G - POWDER, UNEXTENDED
GLUE H - POWDER, UNEXTENDED
GLUE J - HIGH SOLIDS, NON-CRAZING
GLUE K - HIGH SOLIDS, FORTIFIED
JOINT STRENGTH (P.S.I.)
TIME OF EXPOSURE (MONTHS)

Fig. 3.—Effect of continuous exposure to four different temperatures on the joint strength of yellow birch plywood specimens made with seven room-temperature urea-resin glues. Circled values are average wood failure percentages for all glues at each exposure period.

[5] Bensend, D. W. and R. J. Preston. 1954. Some causes of variability in the results of plywood shear tests. FPL Report 1615.

shown as actual plots in Fig. 6. In these figures, the average percentages of wood failure, for all glues at each test period, are shown in circles above the curves. Such wood failure data are valuable to show whether changes in strength are primarily due to effects on the glue or the wood.

There were some variations in control test values for the 11 glues in the birch plywood specimens. Two room-temperature curing glues, the low-solids formulation, E, and the fortified urea resin, K, gave the lowest control values, 263 pounds per square inch for E and 261 pounds per square inch for K (Fig. 3). Two hot-pressed glues (D and I), gave the highest control values, 413 pounds per square inch for D, and 414 pounds per square inch for I (Fig. 4). Since all glues had been used under conditions prescribed by the manufacturers, no attempts were made to modify gluing conditions to improve the quality of the lower strength joints.

The fortified urea-resin, glue K, did not seem to develop its full strength as completely as the others in the initial cure period before control tests (Fig. 3). This was indicated by the greater rates of increase in strength values during the first six months at 80° F. and 65 per cent relative humidity and by the lower reductions in strength of glue K during the first six months of exposure at higher temperatures. These properties were not nearly so noticeable for glue E although both glues had essentially the same initial strengths.

Control values for the five glues in sweetgum plywood (Fig. 5) were from 66 to 74 per cent of the strength values of these glues in birch plywood, and there were similar levels of wood failures. These would be expected because of the lower density of the gum. These control values were in about the same order as those for the same glues in birch plywood. In the laminated joints (Fig. 6) initial high shear strengths and percentages of wood failure indicated good initial quality for all four glues. The actual order was very similar to that of birch plywood.

Fig. 2 includes curves for yellow birch plywood, made with three room-temperature glues and three hot-press glues exposed to 80° F. and 30 per cent relative humidity. Wood in this exposure would not change appreciably from the equilibrium moisture content of 6 per cent, which is within the range typical of wood in the interior of dwellings. There was little change in shear strength for any of the glues in 36 months, and the changes in wood failure were probably not significant. The levels reached at six months were generally maintained,

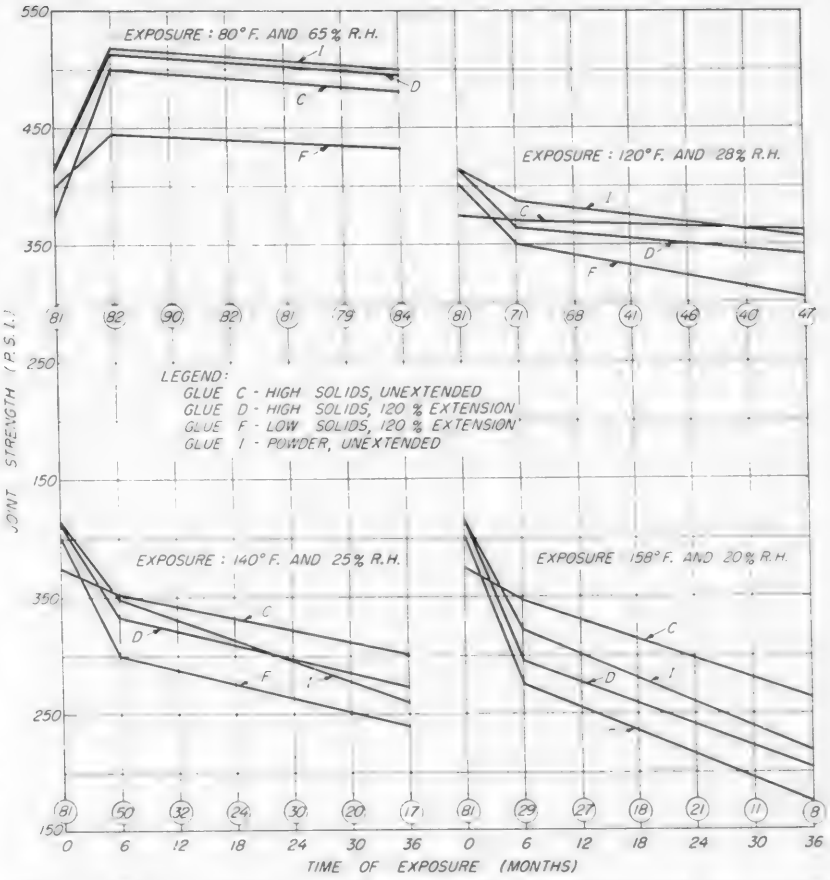
EXPOSURE : 80° F. AND 65% R.H.
EXPOSURE : 120° F. AND 28% R.H.
EXPOSURE : 140° F. AND 25% R.H.
EXPOSURE 158° F. AND 20% R.H.
LEGEND:
GLUE C - HIGH SOLIDS, UNEXTENDED
GLUE D - HIGH SOLIDS, 120 % EXTENSION
GLUE F - LOW SOLIDS, 120 % EXTENSION
GLUE I - POWDER, UNEXTENDED
JOINT STRENGTH (P.S.I.)
TIME OF EXPOSURE (MONTHS)

Fig. 4.—Effect of continuous exposure at four different temperatures on the joint strength of yellow birch plywood specimens made with four hot-press urea-resin glues. Circled values are average wood failure percentages for all glues at each exposure period.

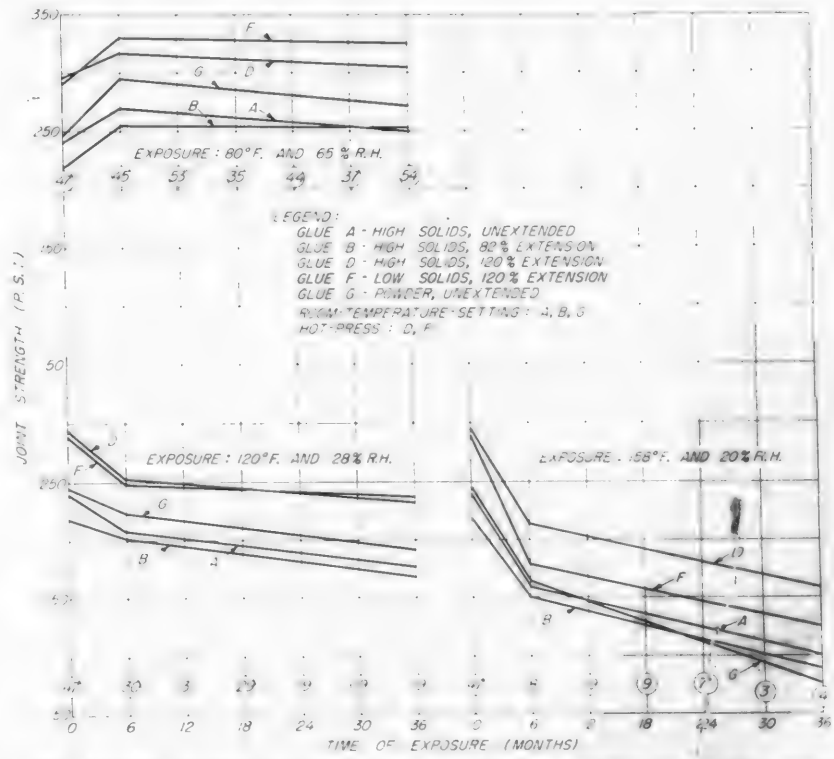
EXPOSURE : 80° F. AND 65 % R.H.
EXPOSURE : 120° F. AND 28% R.H.
LEGEND:
GLUE A - HIGH SOLIDS, UNEXTENDED
GLUE B - HIGH SOLIDS, 80 % EXTENSION
GLUE D - HIGH SOLIDS, 120 % EXTENSION
GLUE F - LOW SOLIDS, 120 % EXTENSION
GLUE G - POWDER, UNEXTENDED
ROOM TEMPERATURE SETTING : A, B, G
HOT-PRESS : D, F
JOINT STRENGTH (P.S.I.)
TIME OF EXPOSURE (MONTHS)

Fig. 5.—Effect of continuous exposure at three different temperatures on the joint strength of sweetgum plywood made with five urea-resin glues. Circled values are average wood failure percentages for all glues at each exposure period.

and no significant effect of this mild exposure was discernible.

Fig. 3 presents curves for birch plywood made with the seven room-temperature glues and exposed to 80° F. and 65 per cent relative humidity, 120° F. and 28 per cent relative humidity, 140° F. and 25 per cent relative humidity, and 158° F. and 20 per cent relative humidity. The slopes of the curves beyond the six-month period at any one temperature were very nearly the same. Each glue retained about the same proportion of its strength after six months, when specimens presumably had reached temperature and moisture content equilibrium and maximum cure. This pattern is most evident for the exposures to 140° and 158° F. The relative levels at six months were similar to those of the controls except for the fortified glue, K, which generally showed less change in strength during the first six months at 120°, 140,° and 158° F. than the other glues. Strength values and percentages of wood failure at each test interval decreased as the temperature increased.

After 36 months' exposure at each temperature, the order of the room-temperature-setting glues, from highest shear strength to lowest, with minor exceptions, was unextended high-solids, A; non-crazing high-solids, J; extended high-solids, B; fortified high-solids, K; unextended powder, G; unextended powder, H; and extended low-solids, E. The average strength loss for all glues in Fig 3, 6 to 36 months' exposure, was 10 per cent at 80° F., 11 per cent at 120° F., 32 per cent at 140° F., and 43 per cent at 158° F. The deleterious effect of increasingly higher temperatures was also shown by decreasing wood failure percentages which indicated that the heat probably affected the glue more than it did the wood. The fortified urea-resin, K, cured at room temperature had no significant advantage in heat resistance when compared to several conventional unfortified urea-resin glues. Previous work[6] at the Forest Products Laboratory showed that melamine resin and resorcinol added in suitable amounts will increase the resistance of hot-press urea-resin glues to aging at 158° F.

Fig. 4 presents curves for birch plywood made with four hot-press glues. The behavior of these glues was similar to that of the room-temperature glues in Fig. 3 except for somewhat lower rates of decline in strength. In general, the levels after 36 months were in the same order as strength levels after 6 months' exposure. Actual levels of original joint strength were

[6] Blomquist, R. F. and W. Z. Olson. 1955. Durability of fortified urea-resin glues in plywood joints. For. Prod. Jour. V(1):50–56.

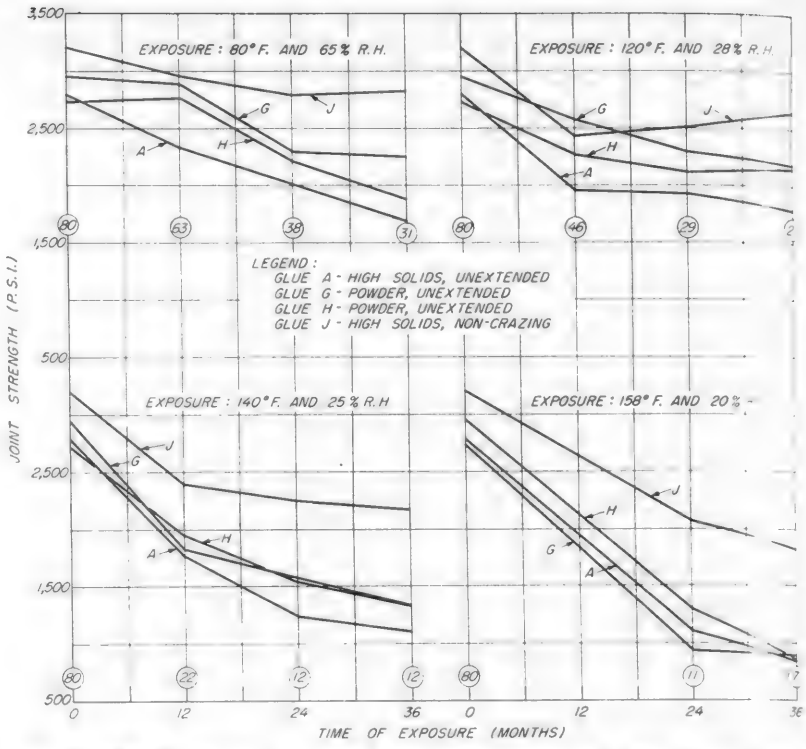
EXPOSURE : 80° F. AND 65 % R.H.
EXPOSURE : 120° F. AND 28 % R.H.
EXPOSURE : 140° F. AND 25 % R.H
EXPOSURE : 158° F. AND 20 %
LEGEND :
GLUE A - HIGH SOLIDS, UNEXTENDED
GLUE G - POWDER, UNEXTENDED
GLUE H - POWDER, UNEXTENDED
GLUE J - HIGH SOLIDS, NON-CRAZING
JOINT STRENGTH (P.S.I.)
TIME OF EXPOSURE (MONTHS)

Fig. 6.—Effect of continuous exposure at four different temperatures on the strength of hard maple block joints made with four urea-resin glues. Circled values are average wood failure percentages for all glues at each exposure period.

higher for the hot-pressed glues than for the cold pressed glues, and the levels after each exposure at elevated temperatures were likewise higher for the hot-pressed glues. The extended low-solids glue, F, was lowest in strength at 36 months at each exposure, and the unextended high-solids glue, C, was highest except at 80° F. The unextended powdered glue, I, and the extended high-solids glue, D, were intermediate.

The average percentage loss in strength for all glues increased as temperatures increased, but at each temperature the decrease was less than that shown for the room-temperature glues in Fig. 3. The average strength loss from 6 to 36 months for the four hot-pressed glues was 4 per cent at 80° F., 7 per cent at 120° F., 19 per cent at 140° F., and 31 per cent at 158° F. Wood failure percentages also declined as the temperature increased, indicating greater effects on the glues than on the wood.

Changes in shear strength of sweetgum plywood made with two hot-press glues and three room-temperature glues exposed to 80°, 120°, and 158° F., and to relative humidities of 65 per cent, 28 per cent, and 20 per cent, respectively, are shown in Fig. 5. Initial control strengths of the sweetgum specimens were lower than on birch, because the wood was of lower density and therefore lower in strength. As indicated by the data in Figs. 3, 4, and 5, the relative performance of glues A, B, D, F, and G on sweetgum plywood was similar to their performance in yellow birch plywood. With both species, the hot-press glues, D and F, had significantly higher initial joint strengths and usually higher percentages of wood failure than the room-temperature-setting glues A, B, and G and they also retained higher levels of strength values than room-temperature-setting glues.

The general order of performance of the five glues after exposure at any of the three temperatures compared was the same on both species. Glue D, the high-solids extended hot-press glue, appeared significantly better in both joint strength and wood failure after exposure to 158° F. than glue F, the corresponding low-solids, hot-press glue, and glue F, in turn, was somewhat better than the three cold-pressed glues. Although initial strength values for gum plywood were lower than for birch, the slope of the curve each temperature was somewhat less for sweetgum than for birch plywood specimens. This indicated a more gradual loss in strength on exposure. As on birch, the level of joint quality of the glues after exposure to elevated temperatures on the sweetgum was generally in the same order as strengths after six months' exposure.

Changes in shear strength of hard

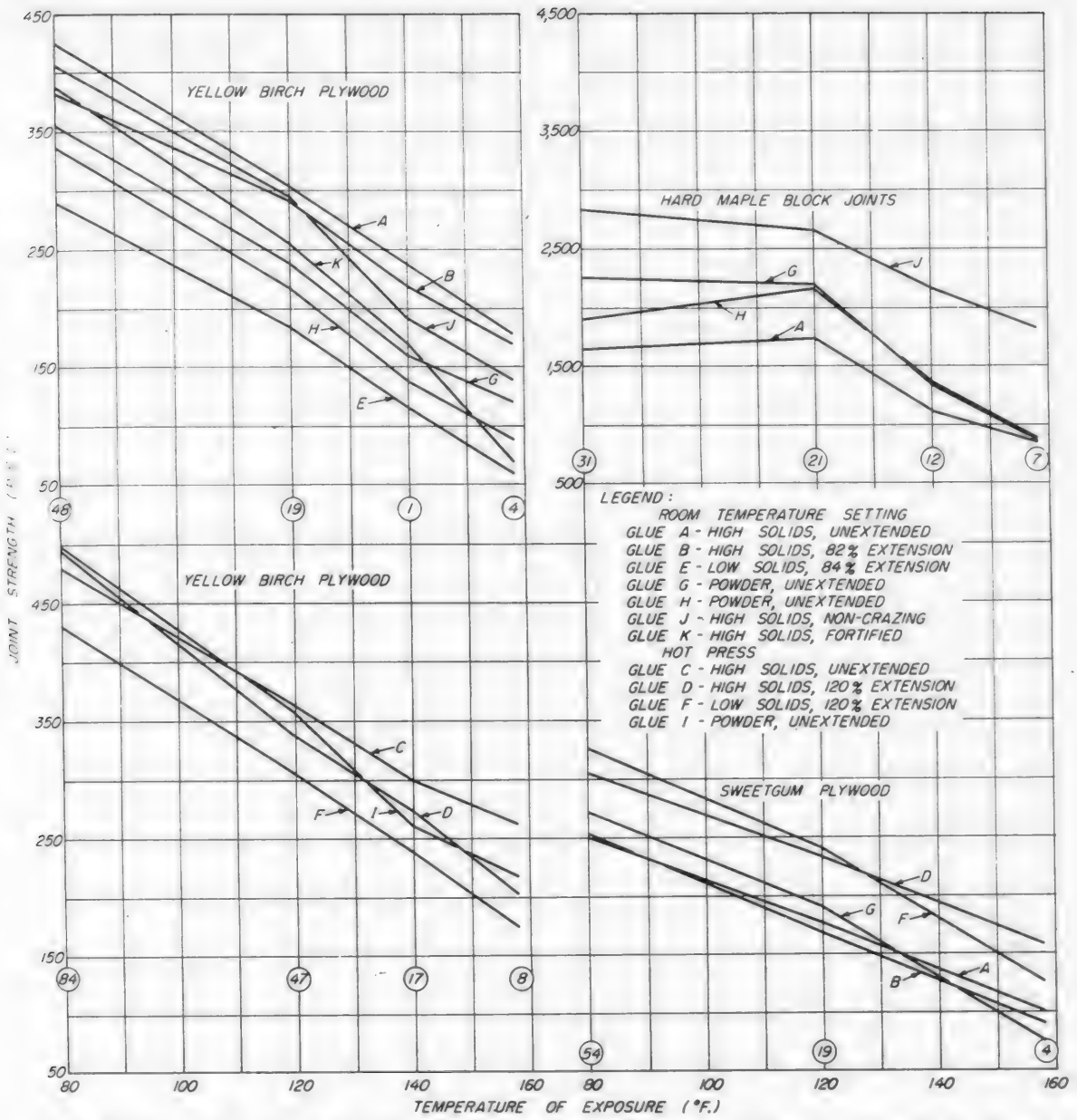
YELLOW BIRCH PLYWOOD
HARD MAPLE BLOCK JOINTS
YELLOW BIRCH PLYWOOD
SWEETGUM PLYWOOD
JOINT STRENGTH (P.S.I.)
TEMPERATURE OF EXPOSURE (°F.)
LEGEND:
ROOM TEMPERATURE SETTING
GLUE A - HIGH SOLIDS, UNEXTENDED
GLUE B - HIGH SOLIDS, 82% EXTENSION
GLUE E - LOW SOLIDS, 84% EXTENSION
GLUE G - POWDER, UNEXTENDED
GLUE H - POWDER, UNEXTENDED
GLUE J - HIGH SOLIDS, NON-CRAZING
GLUE K - HIGH SOLIDS, FORTIFIED
HOT PRESS
GLUE C - HIGH SOLIDS, UNEXTENDED
GLUE D - HIGH SOLIDS, 120% EXTENSION
GLUE F - LOW SOLIDS, 120% EXTENSION
GLUE I - POWDER, UNEXTENDED

Fig. 7.—Relation between exposure temperature and joint strengths after 36 months of continuous exposure of plywood and block-joint specimens made with urea-resin glues. Circled values are average wood failure percentages for all glues at each temperature.

maple block joints made with four room-temperature glues and exposed to 80°, 120°, 140°, and 158° F. are shown in Fig. 6. In this figure, the curves follow the actual points of the data rather than being replotted in smooth curves as those for the plywood specimens in Figs. 2, 3, 4, and 5.

Decreases in both joint strengths and percentages of wood failure are again evident. The high-solids, non-crazing glue, J, was the most durable at all temperatures, followed by the unextended powder, G, unextended powder, H, and unextended high-solids, A. At 80°, 140°, and 158° F, the superiority of this non-crazing glue was very significant. The margin of difference from the other three glues after 36 months' exposure was appreciably greater than the difference in initial control test values. The unextended, high-solids, liquid urea-resin glue, A, which was significantly better than the craze-resistant glue, J, in birch plywood particularly at 140° and 158° F., was lowest or next to the lowest in corresponding performance on maple blocks. The other two glues, G and H, were intermediate in performance on blocks and lower than either A or J on birch plywood. In general, the rate of decrease in strength of the four glues on maple blocks at each temperature was as rapid or more rapid than that for the same glues on birch plywood specimens.

Fig. 7 summarizes the effect of increasing temperature on the various glues in both plywood and block joints over 36 months. The points for these curves were taken from data in Figs. 3, 4, 5, and 6. The rather abrupt changes in slopes at 120° F. for the maple block joint results showed that temperature over 120° F. were more critical than lower temperatures. Slight indications of this can also be seen in some of the curves for plywood. After 36 months at 158° F., the average strength value of block-joints with all glues was only 52 per cent of the average strength value of the same glues after 36 months at 80° F. The aver-

age strength value of all the hot-press glues in both birch and gum plywood after 36 months at 158° F. was 43 per cent of the average strength value after the same period at 80° F., and the corresponding figure for the room-temperature glues was about 30 per cent.

Conclusions

These tests on plywood and laminated joints showed that urea-resin glues, regardless of type or extension, are weakened by continued exposure to temperatures from 120° to 158° F. The higher the temperature of exposure, the greater the effect.

In general, the order of performance of the different urea resins at 120° F. or higher was the same as that of initial control strength levels. Increases in strength values often occurred during the first six months' exposure to 80° F.,and levels of performance over long periods of exposure to 80° F. were generally more directly related to these six months' test values than to the initial controls.

Hot-press glues generally had higher initial strength values and retained levels of greater strength after elevated temperature exposure than room-temperature-cured glues. In general, the high-solids, liquid urea-resin formulations were somewhat superior to formulations of powdered resins, and these in turn were better than formulations of low-solids, liquid resins. Wheat flour extender, as such, had no pronounced effects on heat resistance of any of these resins. One room-temperature-cured, fortified urea-resin glue had no significant advantage in heat-aging resistance when compared to the other conventional urea-resin glues used on plywood.

Discussion

Alan A. Marra (University of Michigan): Most of the curves which relate joint strength with heating time are essentially straight parallel lines displaced vertically by varying amounts. This would indicate that all the adhesives studied behave the same toward heat, but retain a different level of strength at any one time. Since they are as different at zero times as they are after various heating periods, it would seem that the main difference between urea glues with respect to heat resistance is greatly influenced by how strong a bond was produced in the first place. Moreover, it appears some factor can be derived which could be applied to the original strength for the purpose of estimating how well the bond might perform under heated conditions. Can we then say that heat resistance of a urea glue can be expressed as a constant for a given set of conditions?

Mr. Blomquist: I don't believe that the relationship can be that simple. It is true that the slopes of the various curves for different glues are generally quite similar for any given exposure temperature and that the principal differences between glues in one such exposure was therefore apparently in their initial strength levels before exposure. However, I don't feel that we understand what is going on yet adequately to say that the heat resistance is a constant or follows a regular pattern in all cases.

L. E. Clark (Perkins Glue Co.): By unextended mixes were you referring to neat urea resins?

Mr. Blomquist: Yes, but with a conventional amount of walnut-shell flour filler added.

BOOK REVIEW

Annual Report On Wood Protection—1955

Edited by

GUNTHER BECKER and GERDA THEDEN

Berlin-Dahlem, Unter den Eichen 87, West Germany

THIS DIGEST of world literature on the protection of wood against deterioration was founded by Willy Kinberg about 20 years ago, and has been continued by the present editors since 1951. As in previous issues, the literature abstracted in the 1955 Edition, released in November, 1956, is confined to publications that present new data of value in developing and applying protective measures. Most of these publications appeared in 1955 or early 1956; the remainder represent previously overlooked papers from the 1952–1954 period. Beginning with this edition, the Report is expected to be released annually again.

In general content, the new Edition comprises about 300 pages divided into 4 sections—classification of subject matter, abstracts arranged according to this classification, bibliography, and index. The abstracts are presented under the following headings: Fundamentals of Wood Protection; Wood-Destroying Organisms and Their Influence; Wood Protection Against Organisms; Fire-Retarding Wood Protection; Wood Protection Against Chemical Agents; Economical Aspects and Statistics; Reports on Scientific Institutes; Associations, Conventions, International Cooperation; and Personal Notes.

The abstracts, which range from 20 to 200 or more words, are given in both German and English, on facing pages. They carry the author's name and are numbered consecutively, which makes it easy to trace each abstract to its literature source in the bibliography. A new feature is the inclusion of marginal notes to facilitate the search for abstracts of special interest within the broad subject groupings. Also, literature on marine organisms in wood is covered intensively for the first time. With few exceptions, the survey made of literature seems adequate, quality of abstracts is high, and the arrangement of literature under the subject-matter headings seems logical.

The task undertaken by the editors is a large one that has its only reward in the service it performs. Such service undoubtedly will be great if copies of this and subsequent reports are obtained by, or made accessible to, all research workers engaged in wood protection problems. The editors certainly warrant at least this evidence of encouragement and gratitude.

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Gluing High Pressure Decorative Laminates

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The growth, present production, uses, and future of high pressure laminates are discussed. Advantages and disadvantages are pointed out for use of contact cements, urea, casein, and polyvinyl adhesives. Major problems still to be overcome in fabricating plastic-covered products are outlined.

THERE IS CONCLUSIVE EVIDENCE available to substantiate the claim of high pressure laminant manufacturers that the United States produced 150 million square feet of plastic overlay in the year 1955. Every place that one looks today the evidence of this production is on display.

Initially confined during its immedite post-World War II utilization to restaurant tables and soda fountain tops, high pressure laminant overlays have spread into many and varied end products. The small urban cabinet shop which formerly produced store fixtures, kitchen cabinets, breakfast nooks and other related items on a custom basis in many cases has blossomed into a manufacturer of dinette tables. In 1955 there were produced over 4 million such tables.

Indeed, the tremendous growth of this industry in less than 10 years has caused other ramifications. These consist of the larger manufacturers producing their own tubing for chair and table legs, their own plastic sheeting, lumber and plywood cores, and today one manufacturer even makes his own particle board for a core material. Their plastic-covered products now include not just dinette tables, but occasional furniture, library, laboratory and school tables, headboards for beds, children's furniture, china closets, and others.

These plastics are also used for flush door overlays, wall and ceiling paneling, institutional furniture, toys, case goods, airplane interiors, and dozens of other applications. They are extremely durable and decorative. They have been accepted by the consumer.

Sociological Aspects

Why the use of these plastic overlays? Certainly not because of lower cost since rare is the instance where plastic is substituted for a more expensive previous surface. The plastic-covered goods invariably cost more, because of higher raw material costs and because in many cases the item produced is manufactured on a hand, custom-made basis. But the end product itself more ideally suits the way of life into which a good portion of Americans have now evolved.

In the past 10 years, the people of this nation have come to consume more alcohol, soft drinks and cigarettes per capita than ever before. These are all items which sooner or later affect the condition of the furniture in the home and elsewhere. There has also been a tremendous swing towards entertaining in the home more frequently. Statistics show that prior to 1940 Americans consumed 70 per cent of their alcohol out of the home and 30 per cent within. Today these figures are exactly reversed!

Television also has done much to further home entertaining as witnessed by the slump in movie attendance, athletic and other events. Families today are larger than ever before and inhabit smaller living areas with less available outdoor recreation facilities. The tendency towards a more relaxed, informal, liberal way of life has contributed to a greater abuse of furniture in the home than ever previously experienced. The living room in many cases has been transformed to a family-room.

The dining room is being absorbed into an annex of the living or family room. This means three meals a day plus a late snack in this living-dining area. Urban growth with its thousands of small apartments prohibits a separate dining room due to increased rent. And so there has been a great need for a more durable, decorative surface which can easily be cleaned and does not require protective coverings, such as table cloths, place mats or plate glass. This new, more casual American way of life has demanded such a surface and the high pressure laminant is the answer to date.

Fabrication

High pressure laminants for the most part are produced for resale by independent manufacturers who are not manufacturing end products other than the laminants themselves. There are a few exceptions. The laminants produced have now achieved a tremendous variety of surface decoration both in design and color. They are alcohol and liquid-proof. They are practically cigarette- or cigar-proof. The impact resistance is quite good, although they can be scratched with relative ease.

In the majority of furniture fabricating plants, these sheets are purchased from the independent plastic manufacturer. They are then glued to a plywood, lumber core, or particle board core with a plastic or hardboard adhered to the under side as a stabilizing element. There are four separate distinct methods of gluing available which shall be discussed in detail in the section on Gluing.

When the adhesive has set sufficiently, these goods are sent to various machining operations. The top is shaped, grooved, and cut to size as demanded by the design of the end product. It may be banded with chrome, plastic, wood, or self-edged, or it may be left unbanded.

Finally, it is assembled to its other component parts and packaged. It may also have leg fasteners, slides, etc. attached to it and then be shipped in a knock-down condition along with its other members to be assembled by the retailer or ultimate consumer. Dinette tables in particular have taken advantage of this latter aspect with a resulting savings in packaging, handling, freight, and breakage as compared to pre-assembled furniture.

Gluing

As previously stated, there are four methods of gluing available.

Hot Press Method: There are only a scattered few fabricators who hot press high pressure laminants today. This is due to the following facts.

a. This is a relatively new industry with large financial resources not always at hand and with the individual producer's future in plastic overlays sometimes dubious. Hot presses require reasonably well-heated plant facilities, plus a large initial financial

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[1] Presented at Session V, Glues and Gluing, FPRS Fourth National Meeting, June 4–7, 1956, at Asheville, N. C.

[2] Mr. Coufal was Sales Supervisor of National Adhesives Woodworking Dept. when this paper was presented.

The Author: J. W. Coufal holds A.B. and M.A. degrees from Columbia University. He had broad field experience with utilization of polyvinyl resin glues while employed by National Starch Products, Inc. He recently joined the Sales Department of Gray Products Co., Inc., Waverly, Va.

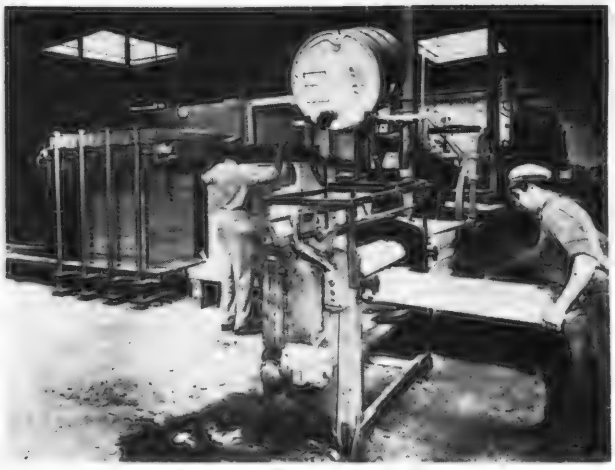


Fig. 1.—Polyvinyl resin is drained directly from drum into glue spreader.

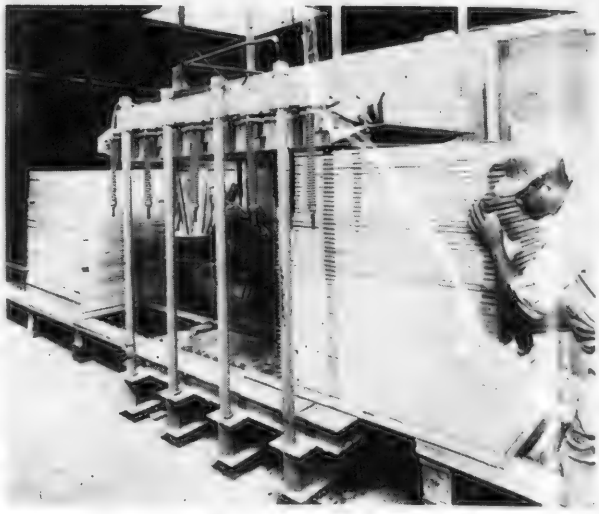


Fig. 2.—Load entering press specifically designed for low pressure laminating standardized operations.

investment. Their resale value is low. They require experience to operate which builds up only over a period of time.

b. There are other methods of gluing which involve relatively low initial investment, less stringent quality controls, and which can produce per man more tables than the hot press.

c. In hot pressing plastic overlays, one must be careful of temperature controls, since these plastics will begin to craze at the elevated temperatures normal to many hot press operations.

It must, however, in all fairness be stated that there are some who are using this method and have done so for a period of years quite successfully. But they are very much in the minority.

Contact Cements: These rapid bonding adhesives have come along during the past four years to find a place in plastic laminating. But like the introduction of every new adhesive to the wood industry, they have had their initial product development difficulties and took some time in ascertaining where best to be utilized.

The marvel of these contact cements is that they approach the perfect production adhesive. Everyone would like to simply coat the surfaces to be glued, combine them, run them through a low cost pinch roller and then have them available almost immediately for machining. This they can do. Yet, there are many other aspects to be considered.

a. The shear strength of contact cements runs in the neighborhood of 1000 psi when bonding plastic to wood. This compares with the 3,000 psi readily available by utilizing ureas, caseins, or polyvinyls. While 1000 psi is entirely sufficient in certain circumstances, the majority of end products call for a greater degree of safety.

b. Labor costs can be reduced by 1/3 to 1/2 in gluing with a contact cement, but the cost of the adhesive pound per pound is three to four times more plus the fact that both surfaces to be adhered must be coated. This brings the glue cost up six to eight times that of other conventional adhesives.

c. Contact cements are volatile in nature, having a low flash point. This means extra production safeguards to prevent accidents. In certain cases, the glue crew is required to wear face masks to prevent irritation. Care is necessary to see that the adhesives are stored properly and used under the proper temperature conditions. They do not have as flexible operating temperatures as do polyvinyls or caseins.

d. They are thermoplastic in nature and an insufficient bond will occur where variances in the core stock prevent firm, adequate contact.

The contact cements are used quite successfully in the fabrication of kitchen sinks, particularly in laminating plastic to a steel base. They are also used in sink tops of plastic to wood being assisted in the majority of cases by the chrome edge band which lips the exterior periphery of the top and also the basin area. They have provided a great saving in time and labor when self-edging dinette tables, occasional furniture, and generally odd-shaped pieces. They are also used to bond plastic coated hardboards to wood frames for occasional furniture.

They are not generally used for large size face laminations which are self-edged because of a combination of the above mentioned disadvantages. These are: cost, handling, thermoplasticity, and the necessity for perfect contact.

Urea and Casein Adhesives: These have a proven record of successful lamination of plastic to wood cores since the innovation of high pressure laminants. They are low in cost, provide durable bonds, and do not present excessive handling problems.

Liquid urea requires a powdered catalyst and a premix. Its pot life will vary from 2 hours in hot weather conditions to 6-8 hours under colder circumstances. However, the warmer conditions sometimes cause pre-cure and the colder temperatures prevent setting for many hours. These are best used with water cooled glue spreaders and heated curing ovens. They require usually 4 to 6 hours minimum under pressure of I-beams and retaining clamps with good gluing conditions. Machining is not until the next day. The major drawbacks of urea resins in plastic laminating are:

a. Slow speed of set. Tie up floor space and pressing equipment.

b. High abrasive characteristics to cutting machines.

c. Lack of flexibility in temperature operating conditions.

d. Limited pot life.

e. Require glue crew to use protective clothing to prevent irritation.

f. Require a premix.

g. If urea is allowed to come into contact with the face of the plastic it will "pick out" the sheet and spoil the top.

They provide a durable bond at a relatively low cost. Their history in the plastic laminating field is a successful one.

Casein also requires a premix, but provides an adequate bond, does not pick out the plastic face despite overnight contact, has less abrasiveness than ureas, and is low in cost. It does require protective clothing for the glue crew.

Casein adhesives perform excellently under low or high temperature operating conditions. In the past

casein adhesives have been usually clamped overnight and machined the next day, although recent developments in these glues have demonstrated that this can be reduced considerably providing temperature conditions are ideal. The exact clamping and machining periods required by these newer formulations on a year-round basis are yet to be proven. Due to the previous history of necessity for long clamping times, the utilization of casein in the plastic laminating picture is that of a minority.

Polyvinyls: The progress of polyvinyl adhesives during the past four years in bonding high pressure laminants to wood cores has been dynamic. There is more polyvinyl adhesive being used today for this purpose than any other type of glue. The vinyls have assumed the intermediate production step between the bonding with ureas or caseins using the I-beam, retaining clamp bale method and the contact cement pinch-roller system. Polyvinyls will not perform simply with a pinch-roller pressing device, but neither are I-beams and retaining clamps necessary.

Fig. 1 shows the polyvinyl adhesive as it comes ready for use, being drained directly from the drum through a spigot valve into the glue spreader. This saves time, is convenient, and keeps dirt, wood chips and other foreign matter out of the glue which is very important in plastic laminating. Note that no protective clothing is necessary when using a polyvinyl. There is no pot life problem to this material as long as the glue rollers are kept rotating. What remains in the spreader at the end of the day may be used the next day or even a week later.

Fig. 2 shows the load entering the press. This clamping device is a low cost hose press which exerts pressure by filling the hose with air. It was specifically designed for low pressure laminating standardized operations, such as plastic overlays or hollow core flush doors. It is quite mobile, simple to operate, and efficient in performance. Note the absence of I-beams and retaining clamps.

Fig. 3 shows the press closed and the load under pressure. 100 lbs. of air pressure on the line exerts about 60 psi over the entire platen area. This is sufficient to effect a rapid bond. The load is kept under pressure 20–35 minutes depending upon the size of the top laminated. During this period another load is built up outside the press. Operating temperatures must be between 60° F. and 12[illegible] F. to use this system successfully. After the load is removed from the press, it is allowed to cure at room

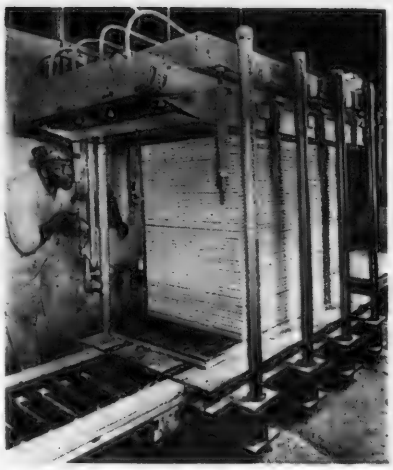


Fig. 3.—Press closed and load under about 60 psi pressure over the entire platen area.

temperature free of an additional clamping device, but undisturbed for 2 to 3 hours. At the end of this period it is ready for any machining operation since the bond has now reached 75 per cent of its maximum strength (or 2500 psi).

Fig. 4 shows a more recent low cost hydraulic press also designed for this process but for smaller sizes of more varied design. This press has a 10- to 12-inch stroke (compared to the air hose press 2-1/2 to 3 inches) and will exert up to 70 psi over the entire platen surface. Note that the top platen is divided into three sections each of which operate independently of the other or as a single unit for larger sizes. This is particularly adaptable for occasional furniture production.

Present Day Problems

There are several major problems still to be overcome in fabricating plastic-covered products. Most of these revolve about securing more suitable core materials rather than gluing, shaping, banding, or other fabricating operations. The plastic overlay industry has now come of age and competition is little short of fierce. Therefore, the industry must turn to:

1. Improved design.
2. Improved quality.
3. Lower cost.

The brightest outlook for attaining numbers 2 and 3 listed above lies with a more suitable core material at a lower cost. Photographing of the core through the plastic and warpage have long plagued this industry. No plywood or lumber core materials to date approach what the plastic fabricator needs except those which are mahogany faced. These are better in regard to photographing but not good enough. Then, there is the problem of

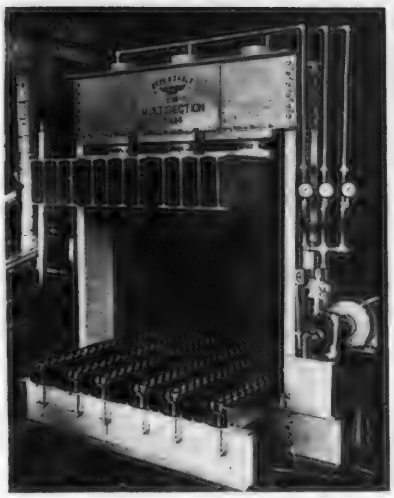


Fig. 4.—Low cost hydraulic press designed for smaller sizes of more varied design.

warpage. The plastic laminator has used back-up materials composed of plastic, tempered hardboards, screen-backed hardboards, impregnated papers, kraft paper, tin foil, and water-resistant coatings, all with success and failures. None provide the answer to preventing warpage. Only contact cement among the glues used will eliminate photographing.

Particle boards provide the lower cost needed, but they have presented screw holding, edge banding, dowel holding, ragged shaper cut, photographing, warping, and other problems. The particle board manufacturers have improved these shortcomings so that today several types are being used by the plastic laminator.

Discussion

Craig C. Campbell (Wynnewood Products): In your paper you quoted some statistics of last year's production of high pressure laminates. How much work is being done in one-shot operations in which the plastic components are bonded directly on high density core?

Mr. Coufal: I do not have specific information concerning this but in all probability the quantity is limited at this point. The future possibilities of this type of operation seem great, however.

Anon: Last year there was a minimum of 8 million feet manufactured in this manner.

B. B. Lane (The Lane Company, Inc.): Can you conclusively attribute telegraphing through plastic surfaces to irregularities in the core, or could it be due also to irregularities of spread of the adhesive or malformation of the plastic?

Mr. Coufal: It is improbable that telegraphing is caused 100 per cent by the core; however, I do not feel that

the glue spread is nearly as important as the surface characteristics of the core. Should the adhesive be mixed improperly or have begun to cure due to lengthy storage, some pressure and thence telegraphing might occur. The plastic sheet itself also at times will have an orange peel appearance before lamination.

Robert Hiller (American Cyanamid Company): The tariff figures as published in trade journals showed a production of 15–17 million pounds of melamine laminating resins during the year 1955. If we assume the average usage as being 40 pounds of melamine per thousand sq. ft. of surface, this would indicate a production of well in excess of 350 million feet.

It has been my experience that telegraphing of the sub-surface through the top surface of the decorative sheet is effected by two factors, namely, the surface and composition of the sub-surface and also the amount of water in the adhesive used in the gluing of the two surfaces. If the core material is of relatively uniform density free of dust and open defects and of the optimum EMC, then I believe the problem becomes one of the proper choice of adhesive and gluing techniques employed with it. Naturally the greater the amount of water in the resin, the greater the shrinkage is when the water is dissipated from the adhesive either by condensation, polymerization, or migration of the water into the core.

Mr. Coufal: The 150 million feet referred to in the presentation concerned itself not with masonite backed plastic foils, but rather with the pure high pressure laminate sheet. That is, the sheet which is laminated by the wood fabricator to a plywood, lumber, or particle board core.

The Care and Grinding of Knives and Cutters[1]

MAX D. PRETORIUS

Proper knife grinding and jointing is a must to insure a quality finish on any wood surface. It is best to joint on the machine prior to removal to the grinding room. Each point should be ground separately rather than use one predetermined setting.

THE QUALITY FINISH of any wood surface (finished by cutters) depends on eight basic factors: (1) spindle speed, (2) feed speed, (3) number of cutters in any given cutterhead, (4) knife grinding and jointing, (5) cutting angle, (6) moisture contents of the material, (7) the machine qualifications and limitations, and (8) the type of operation.

Since quality usually is described and judged by the number of knife marks per inch, proper knife grinding and jointing is of utmost importance to insure quality.

There are three basic types of operations on any moulder:

(1) A machine with straight spindles capable of operation only on 3,600 rpm., usually operated with unjointed knives but can and sometimes is jointed for 3,600 where runs are long and the set up time necessary on the machine can be justified. However, as a general rule this type of operation is usually considered a one-knife finish and can be counted on for relatively slow feed speeds.

(2) A machine with straight spindles but equipped for high frequency and is usually operated on 7,200 rpm. with unjointed knives. Here, there are slightly increased feed speeds compared with item No. 1, provided the majority of runs are not of any great length. With speeds of approximately 50 or 60 feet per minute it is pushing the maximum to still have somewhere near acceptable quality. These two methods can cover up a multitude of sins in the grinding and jointing operation of knives and cutterheads.

(3) A machine equipped with tapered spindles operated on 3,600 rpm. which is basically in operation with the jointed knives in the head. Included in with such an arrangement should be considered a separate jointing and set up stand.

For this discussion consider the No. 3 type of operation.

Jointing Process

When a head has become dull, it is best to joint that particular head on the machine prior to removing it to the grinding room. If a jointing and set up stand is available, the head can be removed, placed in the jointing stand, turned at 3,600 rpm. and jointed there. This is far more desirable since it does reduce the down time of a very important machine. After the head has been jointed it would be taken to the cutterhead grinder. When the head has been set accurately on the tapered spindle in the cutterhead grinder, it is ground to the joint. Where so many people seemingly make their mistake in the grinding operation is in trying to rough and finish grind on one pre-determined setting. Instead, a rough grind should be made on each of the eight points of this 8-point head and if necessary, two or even possibly three rough grinds made prior to the actual finish. If the head has suffered severe knife damage so that 15 or 20 thousandths need to be removed, this should be done in two or three settings. Any rough grind should certainly not exceed a .006 removal at any one time. The stone will not stand anymore than this. It will also have a tendency to head and grab the knife and actually will require too much removal on the finish by irregularities. Once the knives have been rough ground properly across the width of the head and show approximately the same sparking, then a very fine, finish grind should be applied. It should not exceed .001 to .002 for best results.

One of the basic reasons for jointing a so-called dull set of knives is to find the amount of grind necessary so that a surplus of time as well as knife is not wasted in removing an adequate amount for finish grind.

By the finished grind to the joint all of the joint should have been removed, assuming that the joint was properly made on the dull tool and should now be placed for final operational jointing. The head should be placed in the jointing stand, touched very lightly across the width of the knife itself. A good joint for operation should not exceed .002. By so doing, possibly two or three jointings can be achieved between sharpenings with very satisfactory results.

[1] Presented at the Ohio Valley Section Meeting, May 17–18, 1956, in Jasper, Ind.

The Author: Max D. Pretorius was formerly associated with the G. M. Diehl Machine Works.

Around the World in Forest Products Research and Development

Current FAO Equipment Notes

Switzerland

• To increase production capacity and facilitate handling of heavier timber in rough terrain, a combination of the Lasso Cable with the traditional bicable type of overhead cableway has recently been introduced by Lasso Cable S. A., Basle, Switzerland.

This method has an endless, continuous-motion operating cable. It serves as traction cable on the working side, and as carrier cable for the empty carriages and hooks on the haulback side. The loads are suspended on a heavier carrier cable firmly anchored on living trees or "dead men", or tensioned by counterweight in the case of permanent installations.

The loaded carriers are attached to the traction cable with simple clamps by hand, and release automatically at the dumping point. The emptied carriers are returned by continuous motion to the loading station. Traveling at intervals of some 1,000 ft., the carriers can be built for transportation of single logs or bundles of up to 3 metric tons each (depending on size of carrier cable), or shaped as platforms for moving pulpwood bundles, which are automatically dumped at destination.

Units of this type are up to 2½ mi. long, but can be longer. Production capacity is up to 25 metric tons per hour in rough country. Travel speed of the cable is 5 to 7 ft. per seecond, and power required is usually low because gravity power can frequently be utilized. Reported advantages over the older system are cheaper price, simplicity of installation and operation, and flexibility with regard to location in difficult terrain.

FAO Equipment Note C.21.57

France

• A mobile sharpening unit has been constructed by the Centre Technique du Bois, Paris, France, which includes a sharpener, leveling bench, generator set, and space to take several saw bands, swaging, tooth-setting tools, grinders, and so forth. The vehicle has a Renault 2066 type chassis, with rated work load of 1,400 kg., total weight loaded, 3,165 kg., and power rating of 70 h. p.

The cab-chassis was extended 0.8 m., fitted with a wooden-plywood metal body, a platform of elm, uprights of ash, and side and rear frames of spruce. Working space measured 3.80 m. long by 2 m. wide and 2 m. high. It has a two-section side frame, the top raised in operating position. The bottom section drops downward to give room for two saw pulleys.

For sawmills with band saws, the unit has: 1) a sharpener for band and circular saws with interchangeable cams; 2) a leveling bench of hardwood with an inlaid marble surface, faceplate, and tension block; 3) two lockers placed on either side of the sharpener, one fitted with a vice to grip the blade during the swaging of the teeth; and 4) brackets to hang up the saw blades.

For softwood mills, the equipment consists of: 1) a sharpener for reciprocating and circular saws; and 2) a sawtooth setting machine for precision checking of the set given to each tooth. The leveling bench is replaced by lockers to reduce the weight of the truck.

The mobile unit has a 7 kva generator set behind the cab, which supplies a 220- or 350-volt, 3-phase, 50-cycle alternating current. A switchboard and voltmeter complete the electric equipment.

FAO Equipment Note D.17.57

Scanning World-Wide Forest Products Publications

Japan

Biochemical Study of Wood-Rotting Fungi. V. The Enzymatic Oxidation of Lignin. Takayoshi HIGUCHI, Ichiji KAWAMURA and Ikuji HAYASHI. Journal of the Japan Wood Research Society, Vol. 2, No. 1.

In a previous paper, the authors have reported that the laccase extracted from mycelial mat of *Coriolus hirsutus* little catalyze the oxygen consumption by lignins. And VAN VLIET reported recently that the enzyme preparation from mushroom spawn and culture filtrate of *Coriolus versicolor* catalyzed to some extent the oxygen consumption by lignins.

In the present research, in order to confirm whether the oxygen consumption by the lignins in the presence of the culture filtrate of *Coriolus versicolor* was responsible for laccase or other enzyme, the effects on lignins of the laccases of Japanese lacquer and wild mushroom *(Lactarius piperatus)*, of which properties have been well known, was examined.

1. A little oxygen consumption by the lignins in comparison with those by ordinary polyphenols was observed, when a comparatively long period experiment was made by using concentrated enzyme solution. However, this little oxygen consumption should be attributed to the oxidation of free phenolic hydroxyl groups in the lignin, and the oxidation should bring about more extensive polymerization of lignin molecules.

2. On the other hand, from beech decayed wood meal by some wood-rotting fungi, vanillic acid and syringic acid as well as vanillin, syringic aldehyde and coniferyl aldehyde which were considered as lignin degradation products were found. Considering that oxidation products of phenols catalyzed by polyphenol oxidase are generally high polymers, the occurrence of these aromatic aldehydes and acids in the beech decayed wood meal which are considered as lignin degradation products can not be considered to be the result of oxidation of the lignins catalyzed by the laccase in culture filtrates of the white rot fungi.

3. Two species of *Pseudomonas fluorescens*, in spite of giving no BAVENDAMM'S reaction, oxidized readily without adaptive lag time the lignins as well as the above-mentioned aromatic aldehydes and acids, and these oxidations were inhibited by some inhibitors such as NaN_3, 8-hydroxyquinoline and salicylaldoxime.

The Effects of Thickness of Wood Materials on the Electrical Moisture Meter Reading. T. Uyemura. Journal of Japan Wood Research Society, Vol. 2, No. 1.

The effects of various thicknesses of wood materials on electrical moisture meter readings was tested. It was found that the effects of thickness of thin wood materials, plywood and veneer upon moisture meter reading is remarkable on high frequency and on resistance type meters. It follows that moisture measurement with electrical moisture meters of thin materials must be carried out with care and due consideration given to their thickness and property of support table.

Abstracts From Current World Literature

Chemical Utilization

Arne, Frances, and Cannon, D. R. What's ahead for chemicals from wood? Chem. Eng. 63, no 11: 282, 284, 286 (Nov., 1956).

The potential of silvichemicals has remained largely untapped by the forest products industry because a large volume market does not presently exist and would have to be built by the pulp and paper industry, which is unfamiliar with this type of marketing and preoccupied with its major product. Encouraging silvichemical production are the high costs involved in control of pollution, timber processing, and use of natural chemicals. The vast silvichemical potential is being utilized slightly but increasingly in bark-processing plants (producing myricetin and other extractives) and in the recovery of dimethyl sulfide and methyl mercaptan from kraft liquor. Spent sulfite liquor remains the principal source of chemical recovery. Products from this source include carbon-black substitutes, vanillin antioxidants such as β-conidrendrin, alcohol, and the like. [Bul. Pap. Chem. V. 27, No. 4]

Particle Board

Maku, Takamaro, Sasaki, Hikaru, and Hamada, Ryozo. Mechanical properties of chipboard made of flat flake particles. *J. Japan Wood Research Soc.* 2, no. 4: 142–5 (Aug. 1956). [In Japanese; English summary]

Relations between the specific gravity and various mechanical properties (tensile, shearing, and compressive strengths and elastic modulus) of chipboard panels made from Hinoki (*Chamaecyparis obtusa* S. et Z.) are presented, and the stress distribution and bending failure of veneer-overlaid three-ply composite beams are discussed. The panels were made from two types of flat flake particles, 1.3 by 1.2 by 5 by 1.2 cm. in area, each 0.2, 0.5, or 1.0 mm. thick. Tensile and compressive strengths, as well as elastic modulus, varied linearly with specific gravity and independently of particle thickness, whereas shear strength was markedly affected by particle thickness, owing partly to the amount of resin glue spread per unit area. Elastic moduli were nearly equal in tension and compression, whereas tensile strength was comparatively lower than compressive strength. Tensile and compressive strengths and elastic moduli showed linear relationships to each other. [Bul. Pap. Chem. V. 27, No. 6]

Pulping

Anon. New process pulps hardwoods. Chem. Eng. 63, no. 11: 134, 136 (Nov., 1956).

A chemimechanical process for converting any wood to groundwood pulp is gaining widespread use. Any wood capable of being chipped (soft- and hardwood, waste, green or dry wood, frozen wood, etc.) can be used. The chips are pretreated in a rapid-cycle digester with cold caustic or hot sulfite, reduced to shives in a high-pressure press, and processed by the conventional train of disk refiners, rotary screens, and centrifugal cleaners. Pulp is obtained in a yield of 88 to 92% and of a strength equal to or greater than conventional groundwood pulp. The cost of power is about equal, whereas capital and labor costs are lower. The plant requires less than normal space and is sufficiently flexible to be used for conventional softwood pulping. [Bul. Pap. Chem. V. 27, No. 4]

Wood Chemistry

Correns, Erich, and Edelmann, Kurt. Investigation of the course of hydrolysis of wood by continuous conductivity measurements. *Faserforsch. u. Textiltech.* 7, no. 12: 533–40 (Dec., 1956). [In German; Russian and English summaries]

From conductimetric curves obtained during the acid hydrolysis of beechwood, Müller and Dobberstein concluded (*cf.* B. I. P. C. 23: 24) that the minima in the conductivity-time curves were caused by lignin groups splitting off water. The present experiments, carried out on beechwood previously extracted with benzene-alcohol, indicated, on the other hand, that the minima flattened off and disappeared completely with increased time of extraction (removal of extractives). The same observations were made on pure cellulose, holocellulose, and hemicelluloses. Pronounced conductivity-time minima were observed on the evaporation residue remaining after solvent extraction of the wood, whereas no minimum was found for Brauns native lignin. From these results it is concluded that the minima are not due to water liberation by the lignin but are caused by chemical reactions of the wood hemicelluloses dissolved during hydrolysis. These views are supported by measurements of dielectric constants which indicate changes too large to be attributed to water absorption and liberation. [Bul. Pap. Chem. V. 27, No. 8]

Pearl, Irwin A., and Beyer, Donald L. New developments in the chemistry of aspen lignin. *Tappi* 40, no. 1: 45–54 (Jan., 1957).

Aspen spent sulfite liquor has been fractionated by means of isopropyl alcohol into 19 fractions. These fractions were analyzed for methoxyl, sulfur compounds, sugars, and oxidizability by alkaline nitrobenzene. The low methoxyl content of carbohydrate-free fractions indicated an average methoxyl content for aspen lignin of much less than the commonly accepted 21%. Low methoxyl/sulfonate sulfur ratios also indicated a lower average methoxyl value for aspen lignin. Isopropyl alcohol appeared to fractionate the lignosulfonates in solution on the basis of syringaldehyde and vanillin-yielding moieties. Ion-exclusion processes, which satisfactorily separate carbohydrates and lignosulfonates from coniferous spent sulfite liquors, are inoperative in the case of aspen liquor. Ether extraction of aspen spent sulfite liquor gave approximately 2.5% extractives on the basis of liquor solids. The principal component of the extractives was *p*-hydroxybenzoic acid. This compound was also found in the extractives obtained by direct extraction of sound aspenwood with neutral solvents, such as benzene-ethanol. Methoxyl balances are reported for a Klason lignin determination and a sulfite cook of aspenwood. [Bul. Pap. Chem. V. 27, No. 7]

Bark Removal

Anon. The Söderhamn Cambio debarker. *Papier, carton et cellulose* 5, No. 5: 104–5; summaries: 58, 60 (Nov.-Dec. 1956). [In French; English and Spanish summaries]

This hollow-head low-power machine comprises two sets of three spiked feed rolls which push the logs through a rotating ring carrying five sickle-shaped debarking tools. Rubber bands exert tangential pressure on these tools which trace slightly overlapping helical paths on the log and strip the bark without damaging the wood, regardless of the species, size, or shape of the log. The feed rolls and the rotor may be driven by a single motor or by separate special drives. The machine can be mounted on a tractor and driven by an internal-combustion engine for operation in forest areas. A scraper for cleaning the blades and a bark cutter for excessively long strips can be included in the design. Four models are available, ranging in speed from 65–132 to 118–177 f.p.m. and in power from 15–20 and 20–30 to 30–40 and 35–40 h.p. and accommodating log diameters from 1.5–8.0 to 4–26 inches. Trial runs on various wood species gave excellent results. With freshly cut wood there is no fiber loss, and with frozen or very dry wood the loss is only 1%. [Bul. Pap. Chem. V. 27, No. 6]

Finishing

Pateena process. Paripan Ltd. This is a new paint-spray process which can be applied to wood, hardboard or composite woods to give an enamel or metallic colour finish.

A neutral tone texture coat is applied followed by a coat of the desired colour. The surface is said to be resistant to shocks and abrasion and does not require special equipment for application. Either air-drying cellulose or low bake stoving finishes may be used. [F. D. C. Tech. Bul. V. 6, No. 34]

The preparation of abstracts from world literature in many languages is so highly specialized and costly that the Forest Products Research Society has no abstracting service of its own. For the abstracts in this issue of the JOURNAL the Society is indebted to the respective abstract journals indicated, from which they have been selected with the kind permission of the editors. Readers wishing information in addition to that given in these abstracts should consult the original articles referred to. Copies or additional information can not be supplied by FPRS or the abstract journal. The journals from which abstracts are published in this issue are as follows:

BULLETIN OF THE INSTITUTE OF PAPER CHEMISTRY, published monthly at Appleton, Wisconsin by the Institute of Paper Chemistry, subscription price $25 per year. This Bulletin publishes over 3,600 abstracts per year on subjects of interest to manufacturers of pulp, paper, fiberboard and allied products.

CHEMICAL ABSTRACTS, published semimonthly by the American Chemical Society, Executive Office—1155 Sixteenth Street, NW, Washington 6, D. C., subscription price $60 per year plus postage. This abstract journal publishes many thousands of abstracts annually with broad coverage of world literature in the entire field of chemistry and allied subjects.

TECHNICAL BULLETIN OF THE FURNITURE DEVELOPMENT COUNCIL is published bimonthly by the Council at 11 Adelphi Terrace, London W. C. 2, England. The Technical Bulletin publishes hundreds of abstracts and reviews from world literature annually, relating to the various phases of the furniture manufacturing industry. Subscription price is $5 per year.

New Products—Literature

Continued

Packaged Sawmills

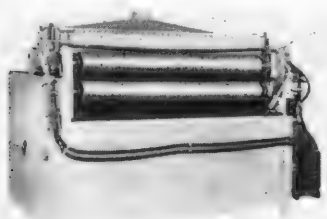
Sawmills employing automation techniques are now available in completely packaged form from Mater Machine Works, Inc., Corvallis, Ore. The packaged mill includes detailed plans for building construction, tested mill layout, list of materials and electric or other drives, automated log haul, automatic log deck, automatic log carriage, automatic offbearer, circular or band equipment, transfers, stops, edger, trimmer, automatic dip tanks, green chains, etc.

According to the firm, the only men required in the mill are the sawyer, who handles the log loading and all carriage and sawing operations; the edgerman, who handles the automatic offbear, transfers, and edger; and the trimmer operator, who handles all material from the edger through the trimmer. Additional provisions can be made where barking and chipping are required.

Mater packaged plans are available for mills cutting up to 50,000 bd. ft. a shift, for ground floor or raised construction and either band or circular headrig.

Production Sander

A Speedsander reportedly designed for faster, smoother wood sanding has been announced by Timesavers, Inc., Minneapolis, Minn. It has a 34-inch feeding height and is said to be adaptable to any production set-up or conveyorized finishing line for sanding or polishing both sides at one pass.



Model "SPL" has automatic belt tracking with feed speeds up to 100 f.p.m. and higher. It is available in widths of 24, 40, 50, and 60 inches.

Pressure Transmitter

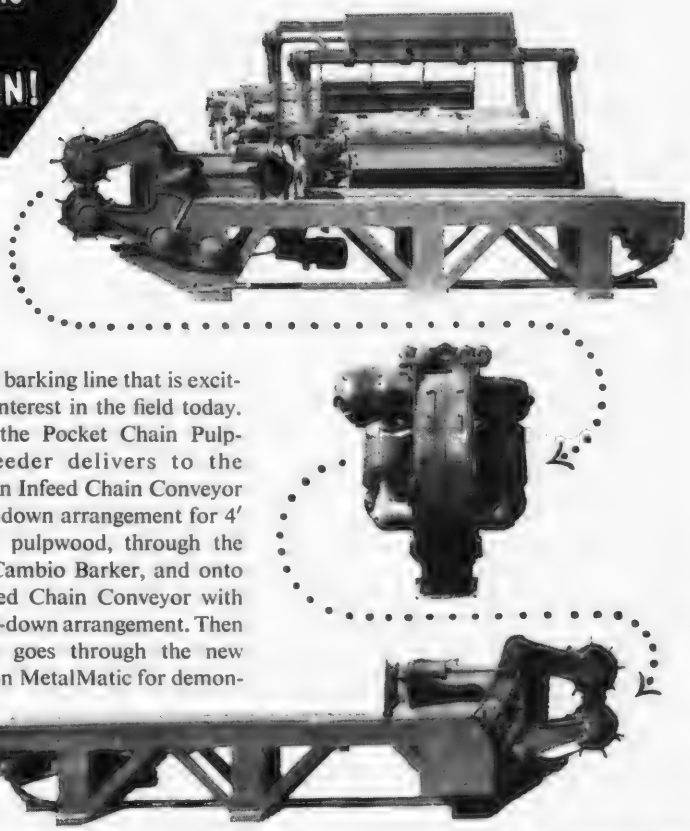
A pressure transmitter for pneumatic transmission of process pressure measurements has been developed by Foxboro Co., Foxboro, Mass. Reportedly accurate to plus or minus ½ per cent of scale range, the transmitter measures pressures of 0–30 inches of water to 0–6,000 psi, transmitting a 3–15 psi air signal to indicating, recording, or controlling instruments.

To accommodate the various ranges, a choice of standard pressure elements is offered—spirals, helicals, bellows and diaphragms. Element materials are available for corrosive process fluids. The transmitter has an eccentric indicating scale built into the front of the case, eliminating the need for a special field gauge.

The stroke of the power feed can be adjusted to suit the length of each slab to be cut, and thickness of the cut is readily adjustable. The cutting system eliminates the machine tender usually employed in cutting operations of this kind, and the uniformity and precision of the work performed tends to cut down on following operations resulting in considerable cost savings, the manufacturer reports.

See this Soderhamn Line IN ACTION!

New film available for showing in your own plant...



Here's the barking line that is exciting keen interest in the field today. See how the Pocket Chain Pulpwood Feeder delivers to the Soderhamn Infeed Chain Conveyor with hold-down arrangement for 4′ and 5′ 3″ pulpwood, through the fast 21″ Cambio Barker, and onto the Outfeed Chain Conveyor with same hold-down arrangement. Then pulpwood goes through the new Soderhamn MetalMatic for demonstration of its sensitive metal detecting, dye-marking and warning signal operation.

Ask for this demonstration film for showing in your own office. Can be shown on any 16 mm. projector.

Make Soderhamn your headquarters for Woodwaste Utilization Equipment

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CHIP SCREENS • GANG SAWS
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West Coast Sales Office: Room 409 Pittock Building, Portland, Oregon
Canadian Representatives, East Coast: Forano Limited, Montreal, Canada

Armstrong Machine Works Becomes FPRS Supporting Member

Armstrong Machine Works, Three Rivers, Michigan, manufacturers of Inverted Bucket steam traps, is one of the newest Company Supporting Members of FPRS. T. H. Rea, Sales Manager, is the firm's designated representative to the Society.

Mr. Rea, associated with the Armstrong Machine Works for nearly 30 years, received an A.B. from Oberlin College in 1919, and an M.A. in Business Administration from Northwestern University in 1922.

The Inverted Bucket Steam Trap, major product of Armstrong, was reportedly originated by the firm nearly fifty years ago. They are used widely for power generated by steam, process work, space heating, and for draining dry-kiln coils at 5 lbs. steam pressure, or power plant piping at 2500 lbs. pressure and 1000° F.

Supplementing the Inverted Bucket Steam Trap is a line of Ball Float Traps for draining water from compressed air, or for venting air from water lines under pressure. Dual gravity ball float traps are also made to open for water, but close to prevent loss of light liquid such as gasoline or propane.

Aerial view of Armstrong Machine Works at Three Rivers, Michigan

In the late 1930's, Armstrong developed a steam humidifier for industrial use. During World War II, furniture plants began making airplane parts of wood. These parts required exacting dimensions that could only be met by control of the relative humidity and emc. This production led to a whole new phase of development for the firm, particularly when furniture manufacturers found that the same controlled relative humidity was also beneficial for their regular products.

Meet FPRS 100 Company Supporting Members

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- Sherwin-Williams Co., Chicago
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MISSOURI
- Monsanto Chemical Co., St. Louis

MONTANA
- Intermountain Lumber Co., Missoula

NEVADA
- Vaughn Millwork Co., Reno

NEW JERSEY
- National Adhesives, Plainfield
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- Oval Wood Dish Corp., Tupper Lake
- Pierce & Stevens Chemical Corp., Buffalo
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- The Upson Co., Lockport

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- Coe Manufacturing Company, Painesville
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- Beecher Falls Mfg. Corp., Beecher Falls

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- Cascade Lumber Co., Yakima
- Columbia Plywood Co., Inc., Seattle
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- Paine Lumber Co., Oshkosh

ALASKA
- Ketchikan Spruce Mills, Ketchikan

CANADA
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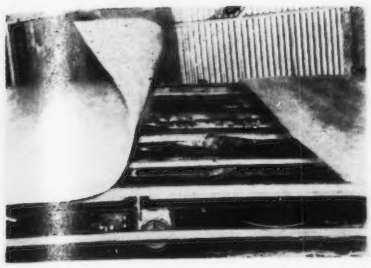
- Canadian Forest Products Limited, New Westminster, B. C.
- Dominion Electrohome Industries, Ltd. Kitchener, Ont.
- Knight Mfg. & Lbr. Co., Ltd., Meaford, Ont.
- MacMillan & Bloedel Ltd., Nanaimo, B. C.
- A. S. Nicholson & Son, Ltd., Burlington, Ont.

New Products—Literature

Continued



New Tipple Control

A tipple control that eliminates the need for manual tearing or breaking in tipple operations on Redco electric veneer-lathe drives has been announced by Republic Electric & Development Co., of Seattle.

With fully or semi-automatic control, it provides a selector switch and action button at the lathe operator's fingertips, which permits pre-selection of trays, automatic control of all tipple-tray hoist movements, and automatic breaking of veneer on the tipple. Tipple speed is automatically synchronized with the speed of the lathe, and an air-jet veneer breaker cleanly breaks veneer up to ¼ inch at speeds over 600 FPM.

Single Application Stains

Wood stains in modern interior tones that fill, seal, and color in one application and do not have to be wiped are being produced by the Martin-Senour Co., Chicago. This new line includes a permanent redwood stain for exterior finish.

The 12 stains are: platinum, driftwood, honey, blondine, bleached redwood, fruitwood, congo, light oak, sage, dark oak, cherry, and teakwood.

Chain Saw Bar Tender

A new double-duty bar tender that regrooves and joints chain saw bars is being manufactured by Oregon Saw Chain Corp., Portland, Ore. Powered by a ¾ h.p. motor with permanent lubrication and thermal overload protector, the bar tender body is made of 18 gauge steel with flat-ground steel working surfaces.

The operator joints the rails and then tilts the machine 90 degrees to regroove the bar. Bar grooves are ground to even width and depth in the exact center of the bar and rails are jointed squarely and of equal height to provide smooth chain surface. The bar tender has two grinding wheels attached to a single shaft and controls include selective groove centering and groove depth adjustments.

Finger Jointer

A new machine that is a radical departure in design from other finger-joint cutting machines has been jointly announced by the Union Tool Corp. and J. D. Wallace & Co., Inc., both of Warsaw, Indiana. The Wallace-Union Automatcher grips the stock in a stationary position and machines the two ends of two separate pieces of wood simultaneously with one stroke, instead of the material passing in front of the cutters as in other machines.

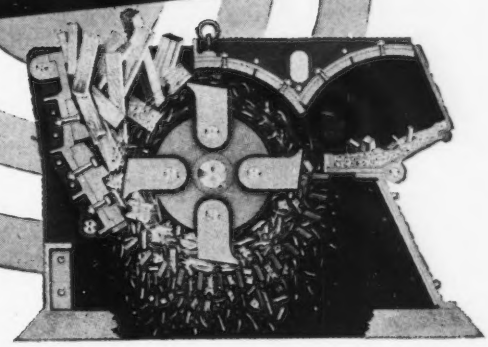
The machine is equipped with a control mechanism which permits setting for tight or loose joints as required by the assembly methods. Other advantages reported by the manufacturer include: handles long or short stock with equal facility; cuts out defects; matches and cuts automatically; is designed for easy control of joint fit; cuts angular joint for superior strength; feeds from either left or right, mechanically or by hand; trim saw blades precede the cutters which form the finger joint, thus assuring precise length of tongue.

New Technical Bulletin

Technical Bulletin No. TP 247, available from the Upson Chemical Corp., Lockport, N. Y., covers the development of new chemical compositions for dimensional stabilization of paper and other forms of cellulose. A technical explanation of the theory and principles of cellulose stabilization covers the use of monoester and other partial esters of polyhydric alcohols and polycarboxylic acids. Examples are given of dimensional stability produced in various types of paper.

MAKE A 2-Way Profit ON WOOD SCRAP!

WILLIAMS "No-Nife" HOGS



Cross section of "No-Nife" Hog showing how fast-revolving chisel-edge hammers reduce wood by impact until properly sized to pass through grate at bottom of machine.

1 Waste wood, automatically conveyed and hogged on Williams equipment, reduces disposal costs up to 75%! One man can handle as much tonnage in chips as three men can handle in awkward pieces and lengths.

2 **If used for fuel,** scrap wood hogged on a Williams is completely combustible, yields maximum BTU's, gives 100% heating value. Unhogged scrap restricts air flow, burns unevenly, smothers the fire, causes excessive smoke.

If sold in chip form to chip board manufacturers, wood refuse processed in a "No-Nife" Hog becomes a top quality product, uniformly ground and sized, and commanding highest prices.

WILLIAMS LINE IS COMPLETE: Hogs, Grinders & Shredders • Vibrating Screens • Air & Mechanical Separators • Heavy Duty Fans • Cyclone Collectors

Complete Brochure On Request— Write For It!

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CRUSHERS GRINDERS SHREDDERS
OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

New Products—Literature

Continued

New Synthetic Fiber

Rayonier, Inc., a pulp producer with Pacific Northwest plants, reports the development of a new synthetic fiber from waste liquor of pulp mills. The fiber is produced from lignin, the binder in wood cells that is almost entirely wasted in the pulp industry. Rayonier finds that even hemlock bark and needles can go into the fiber.

WILCO REFUSE BURNER

Three Models. Complete Range of Sizes. Lowest-cost installation. Prefabricated, one-piece panels. Exclusive triple-draft. Sizing engineers available to you.

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Most satisfactory and permanent of all wood preservatives against decay, fungi, termites and other wood boring insects.

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Most effective, safe and economical treatment made for protection against sap stain fungi. Leaves wood bright and clear. Quick solubility, dustless, non-irritating. Won't damage metal equipment.

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Whatever your problem in the protection and preservation of forest products, this is where you can always get the *right answers quick!* Write or phone.

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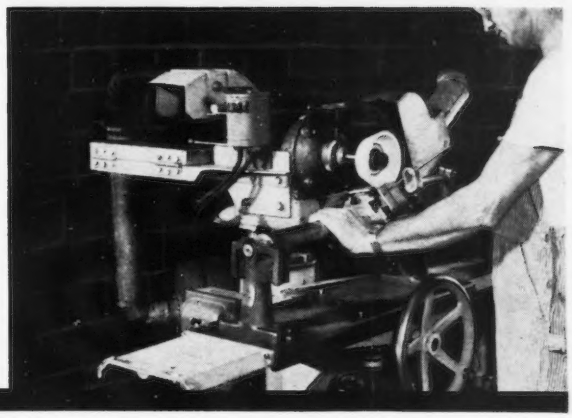
"Micrometer-perfect" door parts produced 4-at-a-pass by Mattison Moulders

AT ROLSCREEN COMPANY



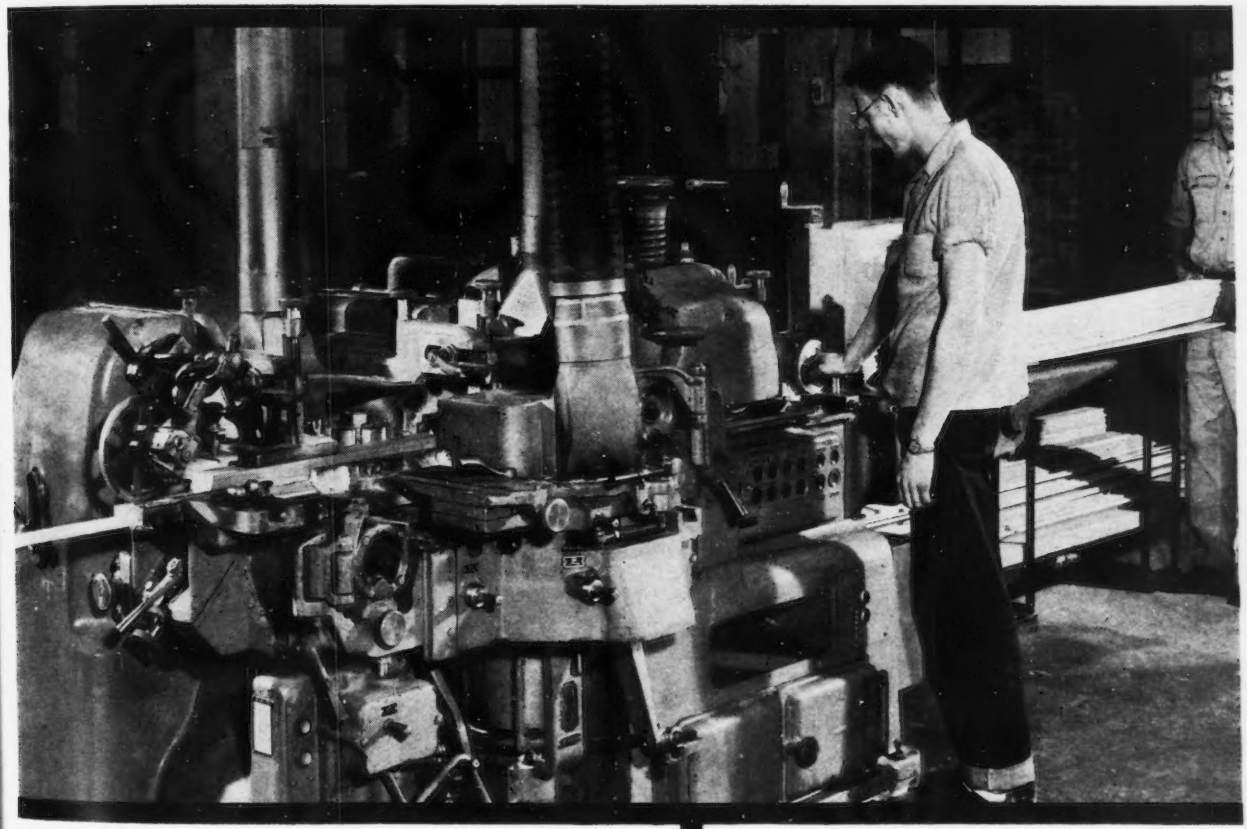
The outstanding success of Rolscreen Company, Pella, Iowa, was the subject of a major article in a national woodworking magazine recently. "We have standardized on the Mattison No. 276 Moulder because the rigid, close-coupled design helps us hold tolerances we gauge with micrometers and dial indicators," says H. S. Kuyper of Rolscreen. The company's popular "Pella" prefabricated windows and wood folding doors require precision manufacture, yet high-speed production.

"One of a number of operations for which we use these soundly designed machines is the manufacture of multiple small mouldings—formed cutters are used to make several mouldings from one piece of material in a single pass through the machine. Production is increased corresponding to the multiple number of pieces obtained per cut."

Another profit-building advantage important in the Rolscreen plant, which covers a city square and operates around the clock, is the low downtime record of their numerous Mattison machines.

"Maintenance is very low, and when we need parts, your service department makes fast stock shipments in most cases," says Mr. Kuyper.

The experience of successful companies like Rolscreen suggests a practical next step in building your own products' success story: call your Mattison dealer *today* and discuss ways to improve production methods, using standard Mattison woodworking machines!



Mattison Machine Works, Rockford, Illinois

Gentlemen: Please send bulletin on Model 276 Moulder ☐ and information on Model 231 Pedestal Grinder (shown at top of ad) ☐.

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City_____ Zone____ State_____

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WOODWORKING MACHINERY

"Built better . . . to produce better quality"

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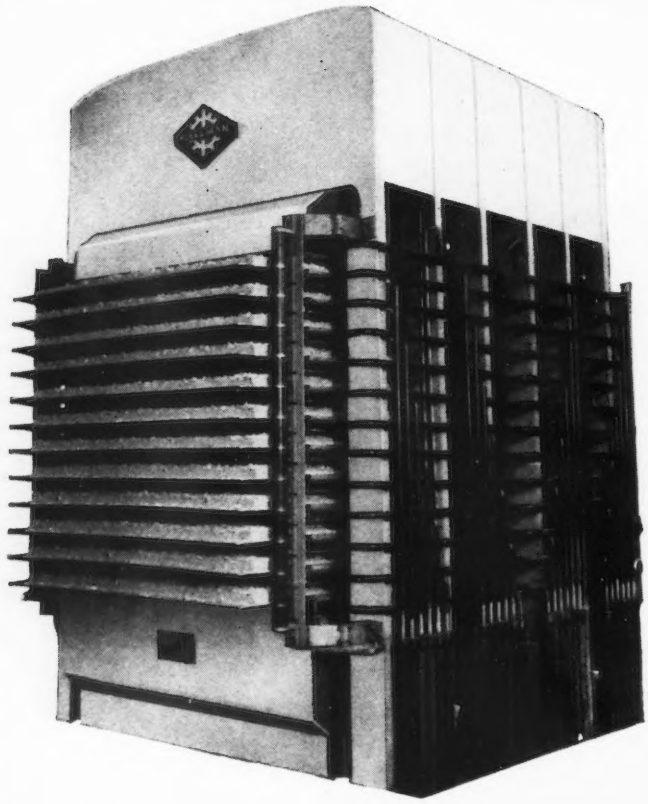
FJELLMAN AMERICAN HYDRAULIC HOT PRESSES



More than ten years research and experience with particle-type board presses—and a close association with top manufacturers here and abroad—has resulted in a Fjellman American hot press capable of producing the finest particle-type board by wet or dry processes, either chip, flake, shaving or fibre.

As with all Fjellman American presses, here's a press built to the highest standard of strength and accuracy for long service and minimum maintenance. Each is precision-engineered from fine Swedish virgin steel. Each has box-type frame, light floor-loading properties, American instruments, wiring and hardware.

Available in a wide range of sizes to accommodate the factory interested in capitalizing on its present wood-waste or the largest manufacturer of wood-composition board.

WRITE FOR CATALOG No. 100-A covering our complete line of industrial hydraulic presses.

Ask your consulting engineer about our presses or write us for complete information on presses readily adapted to your specific particle-type board manufacture.

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Manufacturers of a complete line of "hot" and "cold" presses for the furniture, plywood and plastic industry.